SOIL SURVEY OF

Howard County, Nebraska

United States Department of Agriculture
Soil Conservation Service
in cooperation with
University of Nebraska
Conservation and Survey Division

Issued April 1974

Major fieldwork for this soil survey was done in the period 1962–67. Soil names and descriptions were approved in 1967. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1970. This survey was made cooperatively by the Soil Conservation Service and the University of Nebraska Conservation and Survey Division. It is part of the technical assistance furnished to the Howard County Soil and Water Conservation District.

Either enlarged or reduced copies of the soil map in this publication can be made by commercial photographers, or they can be purchased on individual order from the Cartographic Division, Soil Conservation Service, United States Department of Agriculture, Washington, D.C 20250.

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY contains information that can be applied in managing farms, ranches, and woodlands; in selecting sites for roads, ponds, buildings, and other structures; and in judging the suitability of tracts of land for farming, industry, and recreation.

Locating Soils

All the soils of Howard County are shown on the detailed map at the back of this publication. This map consists of many sheets made from aerial photographs. Each sheet is numbered to correspond with a number on the Index to Map Sheets.

On each sheet of the detailed map, soil areas are outlined and are identified by symbols. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise, it is outside and a pointer shows where the symbol belongs.

Finding and Using Information

The "Guide to Mapping Units" can be used to find information. This guide lists all the soils of the county in alphabetic order by map symbol and gives the capability classification of each. It also shows the page where each soil is described and the page for the capability unit, windbreak group, and range site in which the soil has been placed.

Individual colored maps showing the relative suitability or degree of limitation of soils for many specific purposes can be developed by using the soil map and the information in the text. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those with a moderate limitation can be colored yellow, and those with a severe limitation can be colored red.

Farmers and those who work with farmers can learn about use and management of the soils from the soil descriptions and from the descriptions of the capability units, range sites, and windbreak groups.

Foresters and others can refer to the section "Management of Soils for Windbreaks," where the soils of the county are grouped according to their suitability for trees.

Game managers, sportsmen, and others can find information about soils and wildlife in the section "Management of Soils for Wildlife."

Ranchers and others can find, under "Management of Soils for Range," groupings of the soils according to their suitability for range, and also the names of many of the plants that grow on each range site.

Engineers and builders can find, under "Engineering Uses of Soils," tables that contain test data, estimates of soil properties, and information about soil features that affect engineering practices.

Scientists and others can read about how the soils formed and how they are classified in the section "Formation and Classification of the Soils."

Newcomers in Howard County may be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the information in the section "General Nature of the County."

Cover: **Farm in the southwestern part of Howard County is predominantly Holder soils. Part of the acreage is dryfarmed, part is irrigated, and the rest is range.**

☆ U. S. GOVERNMENT PRINTING OFFICE : 1974 O - 474-882

For sale by the Superintendent of Documents, U.S. Government Printing Office
Washington, D.C. 20402

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SOIL SURVEY OF HOWARD COUNTY, NEBRASKA

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UNITED STATES DEPARTMENT OF AGRICULTURE IN COOPERATION WITH THE UNIVERSITY OF NEBRASKA, CONSERVATION AND SURVEY DIVISION

HOWARD COUNTY is located in central Nebraska (fig. 1). It is approximately square, about 24 miles long and 24 miles wide, and covers an area of 362,240 acres. The county seat and the largest town is St. Paul.

The county was organized in 1871 and was named in honor of General Oliver Otis Howard, a prominent officer during the Civil War. By 1880 the population was about 5,000. Danish, German, Swedish, Polish, and Bohemian were the major nationalities in the early settlements. The population of the county continued to grow from 1870 to about 1920, then it began to decline. In 1900 the population was 10,343; in 1920 it was 10,739; and in 1970 it was 6,659. Most of the people in the county live in towns and villages and depend on farming or farm-related industry for their livelihood.

The soils in Howard County formed mainly on bottom land and stream terraces along the Loup River, on rolling loess uplands, and on hummocky sandhills. A small acreage formed on bottom land along the Platte River. Well drained and moderately well drained soils make up about 49 percent of the county; somewhat excessively drained and excessively drained soils make up about 41 percent; somewhat poorly drained soils that have a water table at a depth of 2 to 6 feet make up 5 percent; and poorly drained, very poorly drained soils, and water areas make up 5 percent.

About 50 percent of the county is cultivated cropland, 45 percent is grassland, and 5 percent is woodland and rivers. About 31 percent, or 59,000 acres, of the cropland is irrigated by water from the Farwell Irrigation District, by deep wells, or by siphoning from the Loup Rivers. Most of the farms are diversified livestock and grain. Corn, sorghum, alfalfa, and wheat are the principal crops, and cattle and hogs are the main livestock. Most of the livestock is shipped out of the county and marketed at Omaha and Grand Island. Market facilities for the farm products are both inside and outside the county. Cash grain crops are sold to the local grain elevators and are shipped to the larger markets by rail and truck. Small quantitites of fruits, vegetables, and hay are marketed locally. There are several commercial honey producers in the county.

Several sand and gravel pits along the Loup Rivers furnish sand and gravel for roads and other construction projects. Public and private recreation areas are being developed for hunting and fishing.

Transportation facilities in the county include a network of hard-surface roads that link all the larger towns and cities; railway branch lines that service St. Libory, St. Paul, Elba, Cotesfield, Dannebrog, Boelus, Farwell, and other smaller towns; and a bus line between St. Paul and Grand Island. A small airstrip north of St. Paul serves local users.

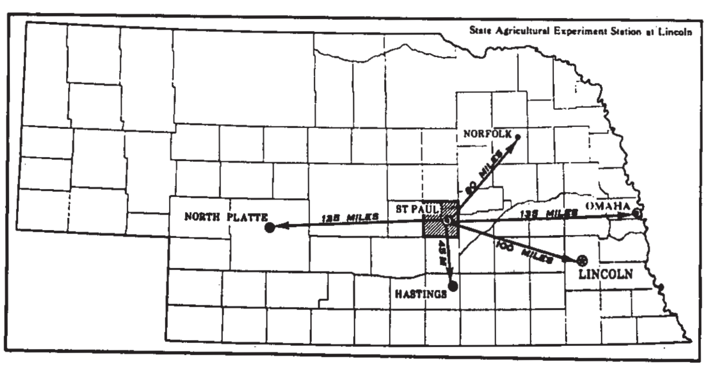

***Figure 1.*—Location of Howard County in Nebraska.**

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soil are in Howard County, where they are located, and how they can be used. The soil scientists went into the county knowing they likely would find many soils they had already seen and perhaps some they had not. They observed the steepness, length, and shape of slopes, the size and speed of streams, the kinds of native plants or crops, the kinds of rock, and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by the action of plant roots.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. The *soil series* and the *soil phase* are the categories of soil classification most used in a local survey.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are simi-

lar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Holder and Hastings, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in those characteristics that affect their behavior in the undisturbed landscape.

Soils of one series can differ in texture of the surface layer and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Holder silt loam, 0 to 1 percent slopes, is one of several phases within the Holder series.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show woodlands, buildings, field borders, trees, and other details that help in drawing boundaries accurately. The soil map in the back of this publication was prepared from the aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning the management of farms and fields, a mapping unit is nearly equivalent to a soil phase. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some other kind that have been seen within an area that is dominantly of a recognized soil phase.

Some mapping units are made up of soils of different series, or of different phases within one series. Soil complexes and undifferentiated groups are two such kinds of mapping units shown on the soil map of Howard County.

A soil complex consists of areas of two or more soils, so intermingled or so small in size that they cannot be shown separately on the soil map. Each area of a complex contains some of each of the two or more dominant soils, and the pattern and relative proportions are about the same in all areas. The name of a soil complex consists of the names of the dominant soils, joined by a hyphen. An example is Coly-Uly complex, 15 to 31 percent slopes.

An undifferentiated group is made up of two or more soils that could be delineated individually but are shown as one unit because, for the purpose of the soil survey, there is little value in separating them. The pattern and proportion of soils are not uniform. An area shown on the map may be made up of only one of the dominant soils, or of two or more. The name of an undifferentiated group consists of the names of the dominant soils, joined by "and." Valentine and Thurman soils, 0 to 17 percent slopes, is an example.

In most areas surveyed there are places where the soil material is so rocky, so shallow, or so severely eroded that it cannot be classified by soil series. These places are shown on the soil map and are described in the survey, but they are called land types and are given descriptive names. Blown-out land is a land type in Howard County.

While a soil survey is in progress, samples of soils are taken, as needed, for laboratory measurements and for engineering tests. Laboratory data from the same kinds of soil in other places are assembled. Data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kinds of soil. Yields under defined management are estimated for all the arable soils.

But only part of a soil survey is done when the soils have been named, described, and delineated on the map, and the laboratory data and yield data have been assembled. The mass of detailed information then needs to be organized in such a way as to be readily useful to different groups of users, among them farmers, managers of woodland and rangeland, and engineers.

On the basis of yield and practice tables and other data, the soil scientists set up trial groups. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others, then adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under present methods of use and management.

General Soil Map

The general soil map at the back of this survey shows, in color, the soil associations in Howard County. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

A map showing soil associations is useful to people who want a general idea of the soils in a county, who want to compare different parts of a county, or who want to know the location of large tracts that are suitable for a certain kind of land use. Such a map is a useful general guide in managing a watershed, a wooded tract, or a wildlife area, or in planning engineering works, recreational facilities, and community developments. It is not a suitable map for planning the management of a farm or field, or for selecting the exact location of a road, building, or similar structure, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect their management.

The nine soil associations in Howard County are described in the following pages. Terms describing texture refer to the surface layer of the major soils in each association unless otherwise stated. Boundaries and names of the soil associations may differ from those in a recently published soil survey of an adjacent county. Such differences result from changes in the concepts of soil classification that have occurred since publication.

1. Holder-Hastings Association

Deep, nearly level to gently sloping, silty soils on uplands

This association is on upland flats and ridgetops. It makes up about 14 percent of the county. Holder soils make up 88 percent of this association. Hastings soils make up 12 percent.

Holder soils are gently sloping. They have a medi-

um-textured surface layer and a moderately fine textured subsoil. They occupy upland flats and ridges. Hastings soils have a medium-textured surface layer and a moderately fine textured subsoil. They are on upland flats. Both soils are well drained. Both formed in loess.

This association is used mainly for cultivated crops. Much of it is irrigated. Farms are 160 to 320 acres in size. Most are diversified cash grain and livestock. Water erosion is the main hazard on the gentle slopes. Insufficient rainfall in most years is the main limitation.

This association is well suited to grass, trees, and other uses. There are good dirt and gravel roads on most section lines. Wells provide water for domestic use on every farm. Many farms have irrigation wells. The Farwell Irrigation Project provides irrigation water for many of the farms in this association.

2. Coly-Holder-Uly Association

Deep, sloping to steep, silty soils on uplands

This association is on the sides of deeply entrenched drainageways throughout the uplands (fig. 2). It makes up about 40 percent of the county. Coly soils make up 30 percent of this association, Holder soils 30 percent, and Uly soils 30 percent. Less extensive soils make up the remaining 10 percent.

Coly soils have a thin, medium-textured surface layer, a thin, medium-textured transitional layer, and calcareous loess underlying material. They are well drained to somewhat excessively drained. Holder soils have a medium-textured surface layer, a moderately fine textured subsoil, and loess underlying material. They are well drained. Uly soils have a medium-textured surface layer,

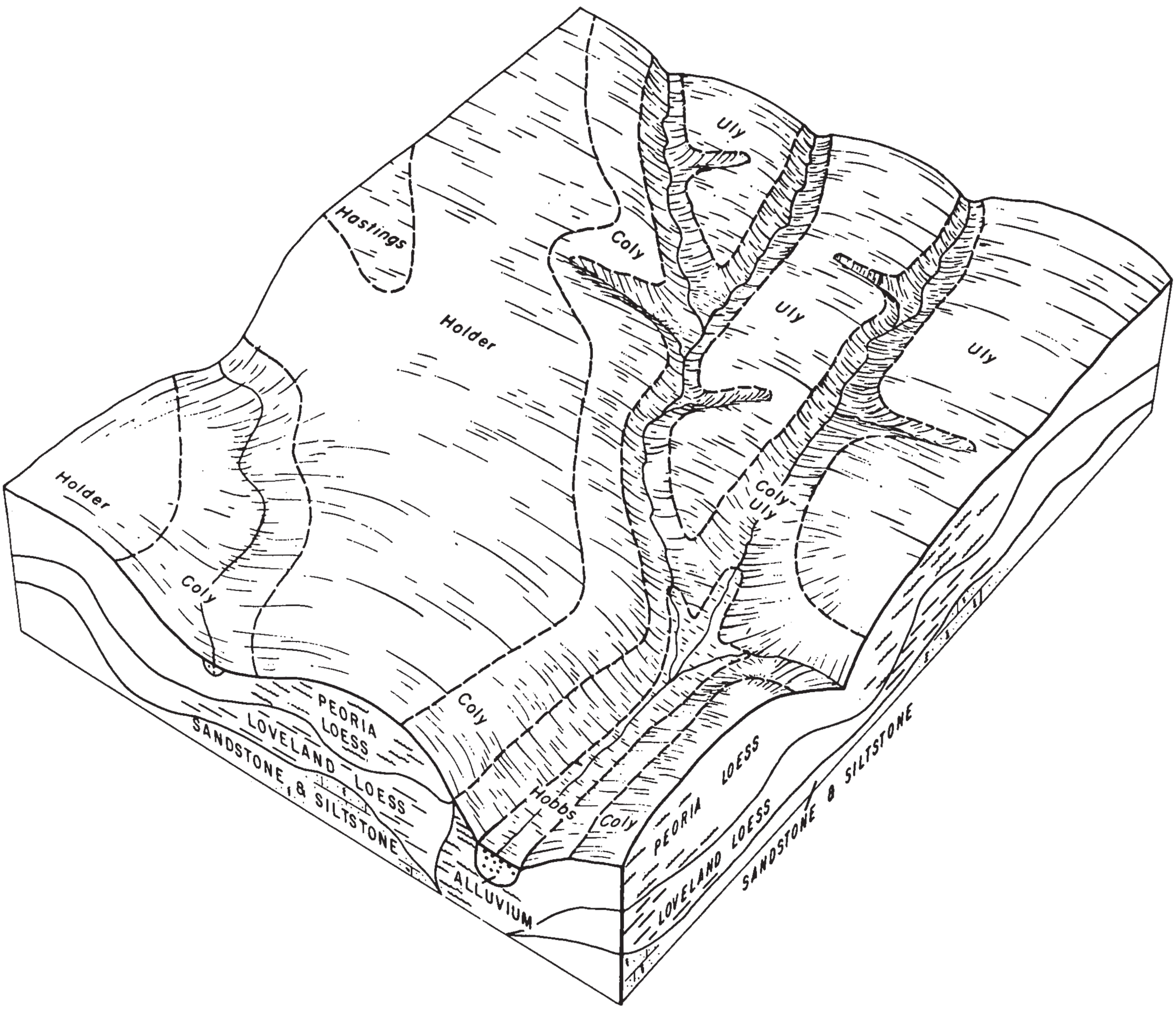

Figure 2.—Typical pattern of soils in association 2.

a medium-textured subsoil, and loess underlying material. They are well drained to somewhat excessively drained.

The less extensive soils are the Hastings soils on upland flats, Hobbs soils on narrow, occasionally flooded upland drains, and the sloping to steep Geary and Nuckolls soils in areas that outcrop along the Loup Rivers. Rough broken land, loess, is very steep and occurs in canyonlike areas in this association.

This association is used for cultivated crops and range. Farms are 160 to 480 acres in size. Most are diversified cash grain and livestock. Water erosion is a serious hazard in cultivated areas and has already removed much of the original surface layer from these soils. Steep areas are too steep, and runoff is too rapid for successful cultivation.

This association is well suited to native grass. It is also suited to trees, recreation areas, wildlife habitat, and other uses. Wells provide water for domestic use on every farm. There are good dirt and gravel roads on most section lines.

3. Hord-Hobbs Association

Deep, nearly level to gently sloping, silty soils on stream terraces and bottom lands

This association is on stream terraces along the Loup Rivers and on bottom land along the major creeks and upland drainageways (fig. 3). It makes up about 8 percent of the county. Hord soils make up 50 percent of this association, Hobbs soils 30 percent, and less extensive soils 20 percent.

Hord soils have a thick, medium-textured surface

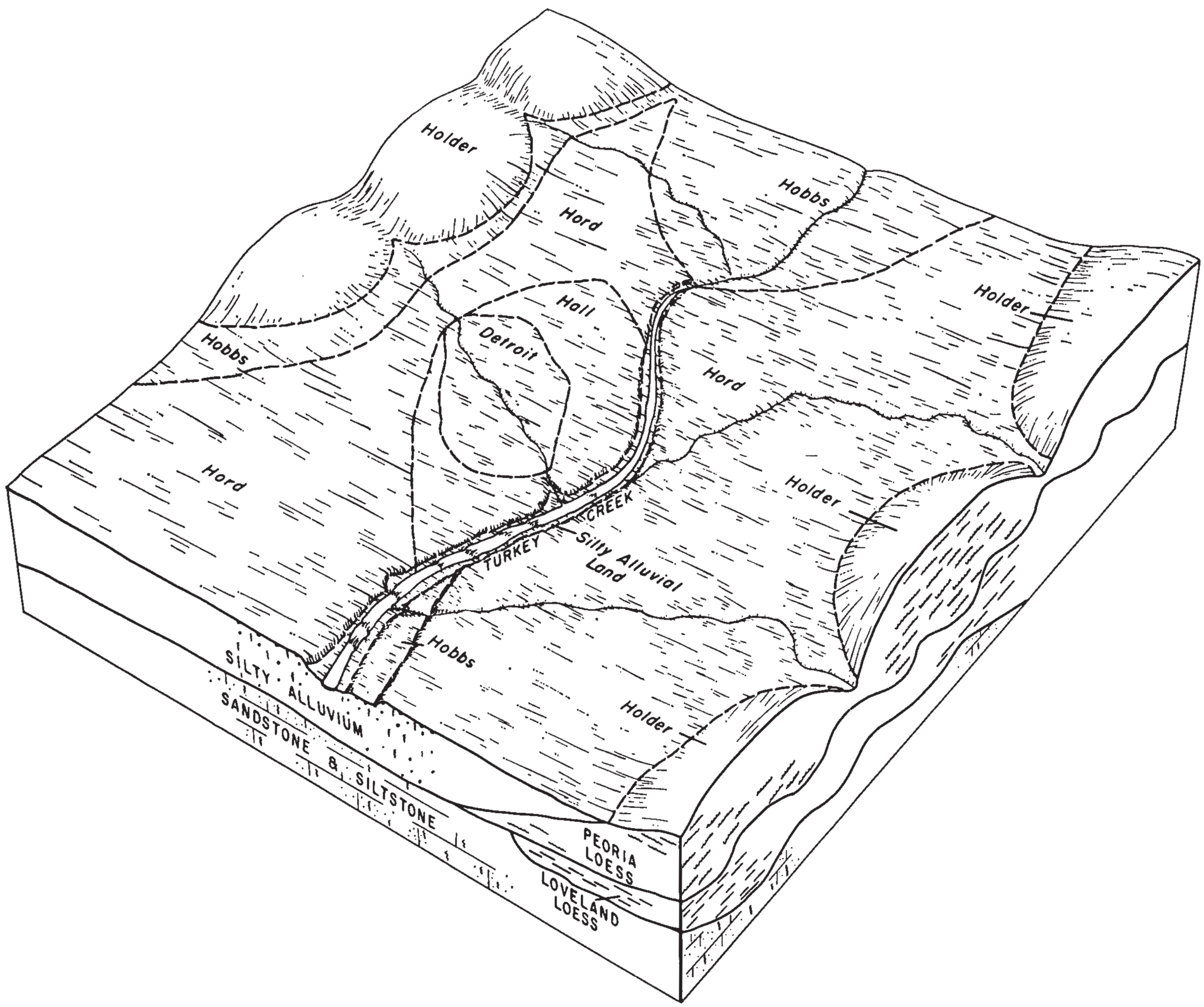

Figure 3.—**Typical pattern of soils in association 3.**

layer, a medium-textured subsoil, and medium-textured underlying material. They are well-drained soils on stream terraces. Hobbs soils have a thick, medium-textured surface layer, a medium-textured transitional layer, and medium-textured underlying material. They occupy some bottom lands that are seldom flooded and some that are occasionally flooded.

The less extensive soils are the nearly level Hall soils on stream terraces next to Hord soils, Detroit soils in slightly concave areas, and Rough broken land, loess, on the short steep slopes between the stream terraces and bottom land. Silty alluvial land occurs along deeply entrenched, intermittent streams and drainageways. It is frequently flooded.

This association is used mainly for cultivated crops, and much is irrigated. Farms are 160 to 320 acres in size. Most are diversified cash grain and livestock. Water erosion is the main hazard on the gentle slopes. Maintaining tilth and fertiltity is the main management concern on both the dryland and irrigated farms.

The soils are well suited to grass, trees, and other less intensive uses. Good dirt and gravel roads are on most section lines. Wells provide water for domestic use on every farm, and many farms have irrigation wells.

4. Kenesaw-Ortello-Libory Association

Deep, nearly level to sloping, loamy and sandy soils on stream terraces and uplands

This association is on nearly level to sloping, undulating uplands and nearly level to very gently sloping stream terraces. The association makes up about 6 percent of the county. Kenesaw soils make up 35 percent of the association, Ortello soils 20 percent, and Libory soils 15 percent. Less extensive soils make up the remaining 30 percent.

Kenesaw soils have a medium-textured surface layer, a medium-textured subsoil, and medium-textured underlying material. They are well drained. Ortello soils have a moderately coarse textured surface layer, a moderately coarse textured transitional layer, and coarse-textured underlying material. They too are well drained. Libory soils have a coarse-textured surface layer, a medium-textured subsoil, and medium-textured underlying material. They are moderately well drained.

The less extensive soils are the nearly level to gently sloping Loretto soils on stream terraces, Rusco soils on the concave terraces, and Thurman and Valentine soils on the hummocky to dunelike uplands. Slickspots are alkali spots that occur at slightly lower elevations than areas of Kenesaw soils.

Most of this association is used for cultivated crops. Much of it is irrigated. The rest is in native grass and is used for range. Farms are 160 to 320 acres in size. Most are diversified cash grain and livestock. Soil blowing and water erosion are the main hazards in unprotected fields. Maintaining good tilth and high fertility is the chief management concern.

This association is suited to trees and to use as wildlife habitat. Many farms have irrigation wells. Wells provide water for domestic use on every farm. There are good dirt and gravel roads on most section lines.

5. Valentine-Thurman-Libory Association

Deep, nearly level to strongly sloping, sandy soils on uplands and stream terraces

This association (fig. 4) is on hummocky and dunelike uplands and nearly level stream terraces. It makes up about 18 percent of the county. Valentine soils make up 44 percent of this association, Thurman soils 40 percent, and Libory soils 9 percent. Less extensive soils make up the remaining 7 percent.

Valentine soils have a thin, coarse-textured surface layer, a coarse-textured transitional layer, and coarse-textured underlying material. They are excessively drained. Thurman soils have a thick, coarse-textured surface layer, a coarse-textured transitional layer, and coarse-textured underlying material. They are somewhat excessively drained. Libory soils have a thick, coarse-textured surface layer, a medium-textured subsoil, and medium-textured underlying material. They are moderately well drained, are nearly level to gently sloping, and occupy terraces.

The less extensive Kenesaw, Loretto, Ortello, Boelus, and Rusco soils are at the edges of the sandhills. Blownout land occurs as small patches throughout the association.

Most of this association is used as range. The soils are generally too steep and too erodible for successful cultivation. Some of the nearly level to gently sloping areas are used for cultivated crops. Soil blowing is a serious hazard if the vegetation is removed.

This association is suited to trees, wildlife habitat, and other uses. On some section lines, there are dirt and gravel roads, but on many there are only trails. Wells provide water for domestic use on every farm and ranch. Farms and ranches range from 160 to 1,280 acres in size.

6. Inavale-Boel-Tryon Association

Deep, nearly level to gently sloping, sandy and silty soils on bottom lands of the Loup River Valleys

This association is mainly on bottom land of the Middle Loup and North Loup Rivers. It is made up of areas adjacent to the river channels and low bottom land. Some areas are on high bottom land and low terraces. The association makes up about 10 percent of the county (fig. 5). Inavale soils make up 32 percent of this association, Boel soils 20 percent, Tryon soils 15 percent, and less extensive soils 33 percent.

Inavale soils have a medium-textured to coarse-textured surface layer and coarse-textured underlying material. They are somewhat excessively drained to excessively drained. Boel soils have a medium-textured to coarse-textured surface layer and coarse-textured underlying material. They are somewhat poorly drained and have a water table that fluctuates between depths of 2 and 6 feet. Tryon soils have a medium-textured to coarse-textured surface layer and coarse-textured underlying material. They are poorly drained and have a water table that fluctuates between the surface and a depth of 3 feet.

Darr, Grigston, Gibbon, Lamo, and Ord soils are the less extensive soils in this association. There are also areas of marsh. They are all on the bottom land.

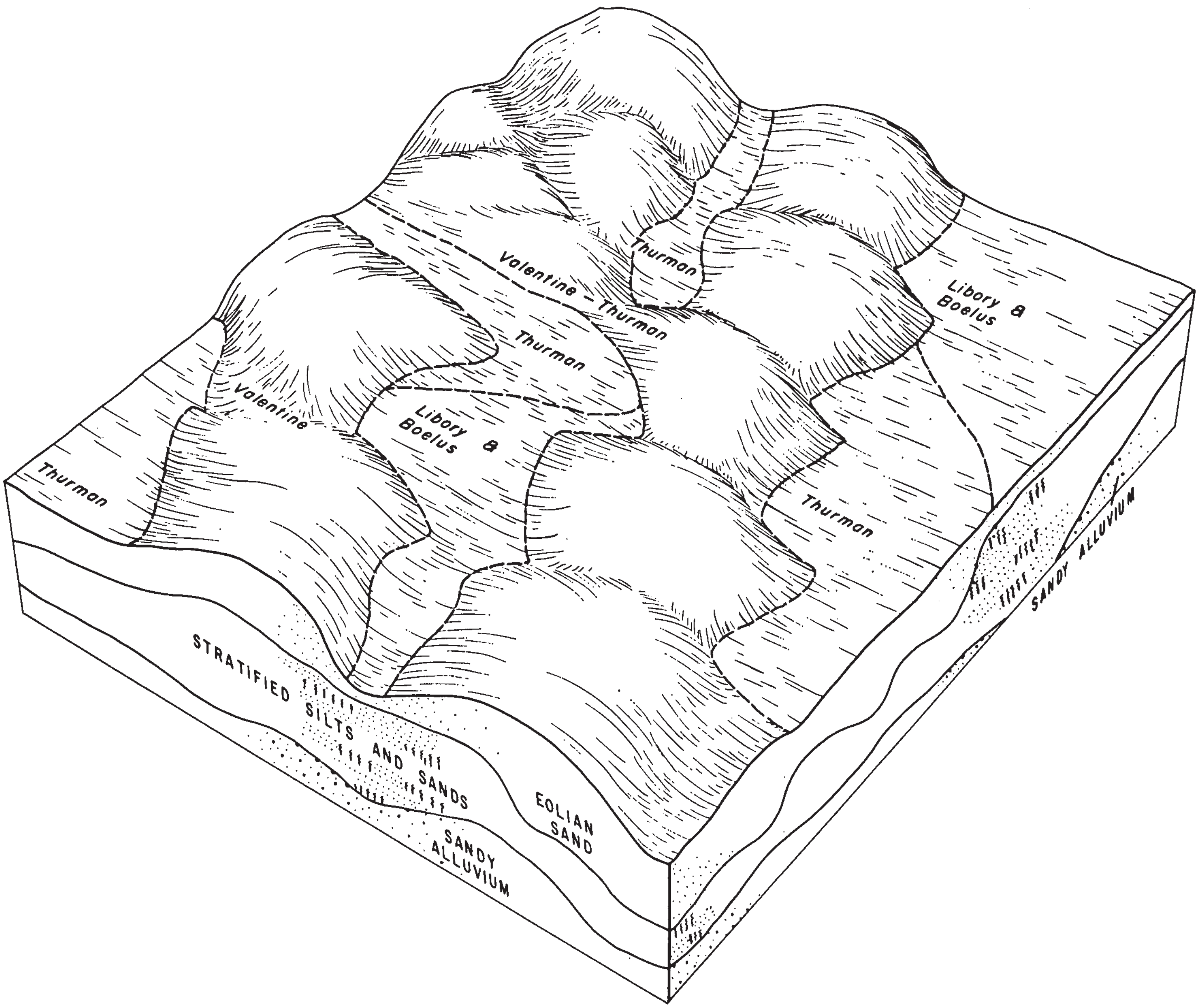

Figure 4.—**Typical pattern of soils in association 5.**

This association is used for range and cultivated crops. Most of it is range. A high water table, low available water capacity, and low fertility are the main management concerns. Soil blowing is a hazard in unprotected sandy areas.

This association is suited to trees, recreation areas, wildlife habitat, and other less intensive uses. There are good dirt and gravel roads on some section lines. There are only a few bridges. Farms are 160 to 320 acres in size. Most are diversified cash grain and livestock. Wells provide water for domestic use on every farm. Some farms have irrigation wells, and some are irrigated with water from the river.

7. Simeon-O'Neill Association

Nearly level to gently sloping, sandy and loamy soils, on stream terraces, that are shallow to moderately deep over sand and gravel

This association is on stream terraces along the Middle Loup River. It makes up about 1 percent of the county. Simeon soils make up 80 percent of this association, O'Neill soils 19 percent, and less extensive soils 1 percent.

Simeon soils are only 10 to 20 inches deep over coarse sand. They are excessively drained. O'Neill soils are 20 to 30 inches deep over coarse sand. They are well drained.

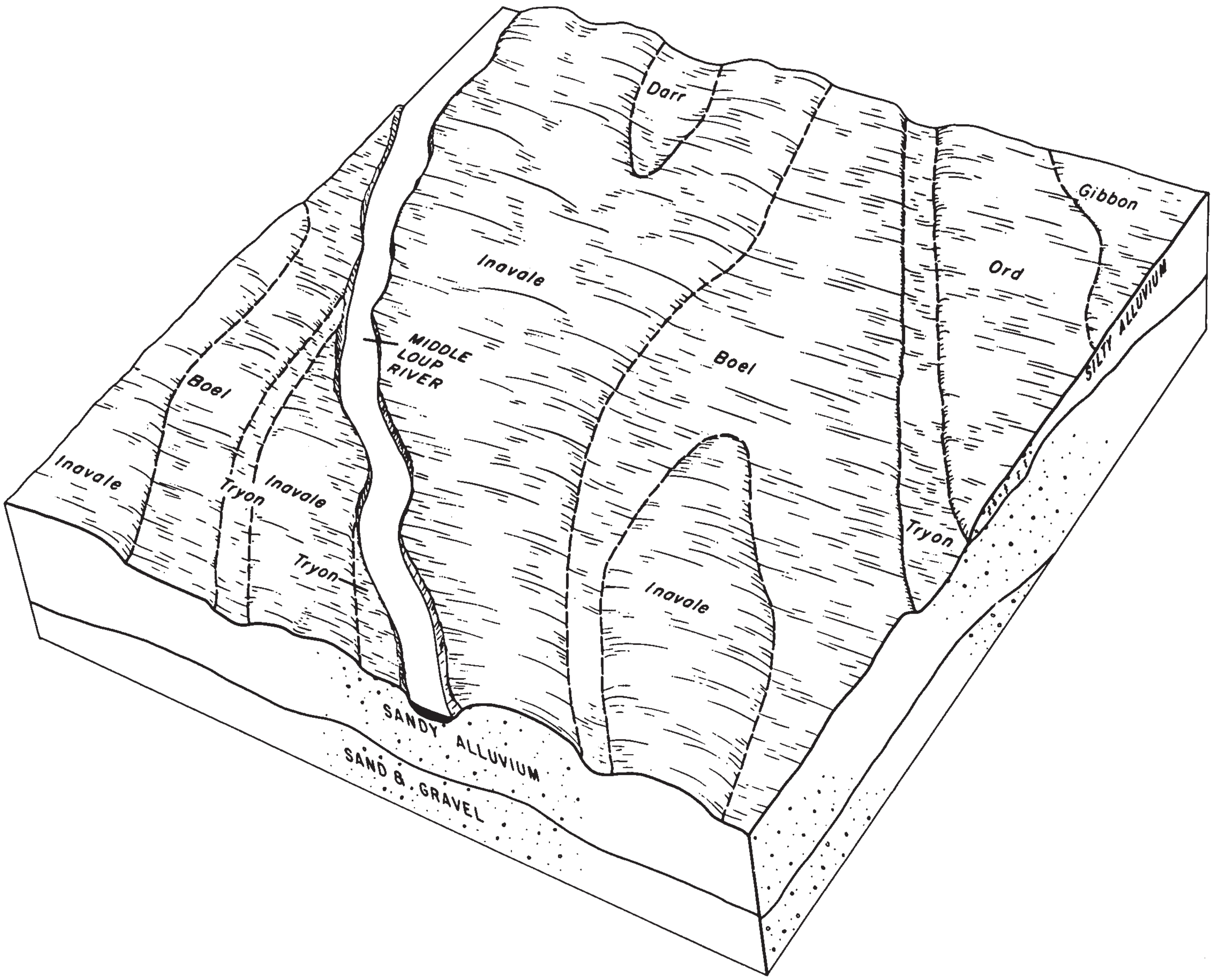

Figure 5.—**Typical pattern of soils in association 6.**

Libory and Boelus are the less extensive soils in this association. They occur on terraces.

This association is used for range and cultivated crops. Most of it is range. Farms are 160 to 320 acres in size. Most are diversified cash grain and livestock. Because the Simeon soils are very low in available water capacity and have a shallow root zone, they are not suitable for cutivation. O'Neill soils are suited to cultivated crops, but because they have a low available water capacity, they are subject to drought.

This association is suited to trees and to other less intensive uses. There are good dirt and gravel roads on most section lines. Wells provide water for domestic use on every farm.

8. Tryon-Elsmere-Gibbon Association

Deep, nearly level to very gently sloping, sandy and silty soils on stream terraces and bottom lands

This association is on the high bottoms and stream terraces in the Loup and Platte River Valleys. It makes up about 2 percent of the county. Tryon soils make up 36 percent of this association, Elsmere soils 24 percent, Gibbon soils 18 percent, and less extensive soils 22 percent.

Tryon soils have a medium-textured to coarse-textured surface layer and coarse-textured underlying material. They are poorly drained. Elsmere soils are coarse-textured throughout and are somewhat poorly drained. Gibbon soils are medium-textured throughout and are somewhat poorly drained.

Lamo, Ord, Ovina, and Thurman soils are less extensive soils in this association. Lamo, Ord, and Ovina soils are on bottom land, and Thurman soils are on sandy terraces.

This association is used for cultivated crops and range. Poorly drained areas that are too wet for cultivation are in native grass. Farms are 160 to 320 acres in size. Most are diversified cash grain and livestock. The Tryon soils are too wet for cultivation. Wetness that delays seedbed preparation is the main limitation. Low available water capacity limits the use of Tryon and Elsmere soils. Soil blowing is a hazard on the unprotected sandy soils.

This association is suited to trees, recreation areas, wildlife habitat, and other less intensive uses. There are good dirt and gravel roads on most of the section lines. Wells provide water for domestic use on every farm, and some farms have irrigation wells.

9. Silver Creek-Slickspots Association

Deep, nearly level to very gently sloping, saline and alkali soils, on stream terraces, that have a silty surface layer and a clayey subsoil

This association is on stream terraces in the Platte River Valley. It makes up about 1 percent of the county. Silver Creek soils make up 65 percent of this association, Slickspots 26 percent, and less extensive soils 9 percent.

Silver Creek soils have a medium-textured surface layer, a moderately fine textured subsoil, and medium-textured underlying material. They are somewhat poorly drained and have a water table that fluctuates between depths of 5 and 8 feet. Slickspots have a medium-textured surface layer, a moderately fine textured subsoil, and moderately fine textured underlying material. They are moderately well drained and have a water table that fluctuates between depths of 5 and 8 feet. Slickspots are strongly alkali or moderately saline.

Less extensive in this association are the nearly level, well-drained Hord and Hall soils.

This association is used mainly for cultivated crops. Some of it is irrigated. The rest is in native grass and is used for range. Farms are 160 to 320 acres in size. Most are diversified cash grain and livestock. The slickspots are the main management concern in this association. They are alkali or saline and occur as areas 20 to 100 feet in diameter. When dry, they are hard and cloddy; when wet, they are sticky. They are difficult to till.

This association is suited to trees and other uses. There are good dirt and gravel roads on most section lines. Wells provide water for domestic use on every farm, and many farms have irrigation wells.

Descriptions of the Soils

This section describes the soil series and mapping units in Howard County. Each soil series is described in considerable detail, and then, briefly, each mapping unit in that series. Unless it is specifically mentioned otherwise, it is to be assumed that what is stated about the soil series holds true for the mapping units in that series. Thus, to get full information about any one mapping unit, it is necessary to read both the description of the mapping unit and the description of the soil series to which it belongs.

An important part of the description of each soil series is the soil profile, that is, the sequence of layers from the surface downward to rock or other underlying material. Each series contains two descriptions of this profile. The first is brief and in terms familiar to the layman. The second, detailed and in technical terms, is for scientists, engineers, and others who need to make thorough and precise studies of soils. Unless it is otherwise stated, the colors and consistence mentioned in the descriptions are those of a dry soil.

As mentioned in the section "How This Survey Was Made," not all mapping units are members of a soil series. Blown-out land, for example, does not belong to a soil series but is listed in alphabetic order along with the soil series.

Following the name of each mapping unit is a symbol in parentheses. This symbol identifies the mapping unit on the detailed soil map. Listed at the end of each description of a mapping unit is the capability unit, the range site, and the windbreak group in which the mapping unit has been placed. The page for the description of each capability unit, range site, or windbreak group can be found by referring to the "Guide to Mapping Units" at the back of this survey.

The acreage and proportionate extent of each mapping unit are shown in table 1. Many of the terms used in describing soils can be found in the Glossary at the end of this survey, and more detailed information about the terminology and methods of soil mapping can be obtained from the Soil Survey Manual (*9*).[1]

A given soil series in this county may be identified by a different name in a recently published soil survey of an adjacent county. Such differences in name result from changes in the concepts of soil classification that have occurred since publication. The characteristics of the soil series described in this county are considered to be within the range defined for that series. In those instances where a soil series has one or more features outside the defined range, the differences are explained.

Blown-out Land

Blown-out land (5 to 15 percent slopes) (B) is eolian sand. It occupies areas that are within areas of Valentine soils. It is excessively drained. Permeability is rapid, available water capacity is low, runoff is slow, and natural fertility is low.

Blown-out land is mainly the result of excess trampling or overgrazing near watering places. These areas have little or no vegetation, and the sand shifts freely with the wind.

Until a vegetative cover is established, these blown-out areas are subject to soil blowing. If the areas are fenced in and the livestock kept out, they can be mulched and reseeded to native grass. Some need smoothing before seeding. Capability unit VIIe-5 dryland; Sands range site; Very Sandy windbreak group.

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[1] Italic numbers in parentheses refer to Literature Cited, page 87.

TABLE 1.—*Approximate acreage and proportionate extent of the soils*

Soil	Area	Extent	Soil	Area	Extent
	Acres	*Percent*		*Acres*	*Percent*
Blown-out land	441	0. 1	Kenesaw silt loam, 5 to 11 percent slopes	791	0. 2
Boel loamy fine sand	1, 764	. 5	Kenesaw-Slickspots complex	2, 063	. 6
Boel fine sandy loam	1, 019	. 3	Lamo silt loam	305	. 1
Boel loam	4, 592	1. 3	Libory-Boelus fine sands	1, 044	. 3
Coly silt loam, 5 to 11 percent slopes	15, 906	4. 4	Libory-Boelus loamy fine sands	8, 287	2. 3
Coly silt loam, 11 to 31 percent slopes	24, 419	6. 7	Loretto complex, 0 to 5 percent slopes	2, 809	. 8
Coly-Uly complex, 15 to 31 percent slopes	42, 774	11. 8	Marsh	385	. 1
Darr fine sandy loam	496	. 1	Nuckolls soils, 15 to 31 percent slopes, severely eroded	2, 527	. 7
Darr silt loam	1, 164	. 3	O'Neill loam, 0 to 3 percent slopes	860	. 2
Detroit silt loam, 0 to 1 percent slopes	460	. 1	Ord fine sandy loam	501	. 2
Elsmere loamy fine sand	1, 745	. 5	Ord loam	3, 991	1. 1
Geary soils, 7 to 11 percent slopes, severely eroded	394	. 1	Ortello loamy fine sand, 1 to 5 percent slopes	1, 917	. 5
Geary soils, 11 to 15 percent slopes, severely eroded	709	. 2	Ortello fine sandy loam, 0 to 1 percent slopes	732	. 2
Gibbon silt loam	1, 820	. 5	Ortello loam, 0 to 1 percent slopes	1, 277	. 4
Grigston silt loam	742	. 2	Ortello loam, 1 to 5 percent slopes	734	. 2
Hall silt loam, 0 to 1 percent slopes	2, 255	. 6	Ortello-Coly complex, 15 to 31 percent slopes	482	. 1
Hastings silt loam, 0 to 1 percent slopes	6, 255	1. 7	Ovina loamy fine sand	822	. 2
Hobbs silt loam, 0 to 1 percent slopes	3, 264	. 9	Rough broken land, loess	1, 870	. 5
Hobbs silt loam, occasionally flooded	5, 880	1. 6	Rusco silt loam	1, 838	. 5
Hobbs silt loam, 1 to 3 percent slopes	8, 581	2. 4	Silty alluvial land	4, 132	1. 1
Hobbs silt loam, 3 to 5 percent slopes	3, 709	1. 0	Silver Creek-Slickspots complex	1, 281	. 4
Holder silt loam, 0 to 1 percent slopes	15, 314	4. 2	Simeon loamy sand, 0 to 3 percent slopes	3, 625	1. 0
Holder silt loam, 1 to 3 percent slopes	22, 106	6. 1	Thurman fine sand, 0 to 5 percent slopes	670	. 2
Holder silt loam, 3 to 5 percent slopes, eroded	6, 605	1. 8	Thurman loamy fine sand, 0 to 3 percent slopes	6, 562	1. 8
Holder silt loam, 5 to 11 percent slopes	4, 361	1. 2	Thurman loamy fine sand, 3 to 5 percent slopes	4, 650	1. 3
Holder silty clay loam, 5 to 11 percent slopes, eroded	12, 943	3. 6	Thurman loamy fine sand, loamy substratum, 0 to 3 percent slopes	2, 337	. 7
Holder silty clay loam, 5 to 11 percent slopes, severely eroded	14, 701	4. 1	Tryon loam	1, 834	. 5
Hord silt loam, 0 to 1 percent slopes	13, 334	3. 7	Tryon soils, drained	6, 182	1. 7
Inavale fine sand	5, 451	1. 5	Uly silt loam, 5 to 11 percent slopes	7, 129	2. 0
Inavale loamy fine sand	5, 056	1. 4	Uly silt loam, 11 to 15 percent slopes	3, 725	1. 0
Inavale fine sandy loam	721	. 2	Valentine fine sand, rolling	5, 478	1. 5
Inavale loam	925	. 3	Valentine and Thurman soils, 0 to 17 percent slopes	41, 247	11. 4
Kenesaw silt loam, 0 to 1 percent slopes	3, 117	. 9	Water (Loup River, canals, and ponds)	4, 460	1. 2
Kenesaw silt loam, 1 to 5 percent slopes	2, 670	. 7	Total	362, 240	100. 0

Boel Series

The Boel series consists of deep, somewhat poorly drained, nearly level to very gently sloping soils on bottom land in the Loup River Valleys. These soils formed in alluvium. The water table fluctuates between depths of 2 and 6 feet.

In a representative profile the surface layer is dark-gray fine sandy loam about 8 inches thick. Below this is a transitional layer of grayish-brown fine sandy loam 3 inches thick. The underlying material is fine sand. It is white in the upper part and light gray in the lower part. It has dark reddish-brown mottles.

Boel soils are calcareous at the surface and moderately alkaline throughout the profile. Permeability is rapid, available water capacity is low, and natural fertility is medium.

Boel soils are suited to range and cultivated crops. Most of the acreage is used for range and hay.

Representative profile of Boel fine sandy loam in native grass range, 200 feet east and 0.4 mile north of the southwest corner of sec. 4, T. 13 N., R. 10 W.:

A—0 to 8 inches, dark-gray (10YR 4/1) fine sandy loam, very dark brown (10YR 2/2) when moist; weak, medium, subangular blocky structure parting to weak, very fine, granular; soft when dry, very friable when moist; calcareous, moderately alkaline; smooth boundary.

AC—8 to 11 inches, grayish-brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) when moist; weak, coarse, subangular blocky structure parting to weak, very fine, granular; soft when dry, very friable when moist; calcareous, moderately alkaline; clear, wavy boundary.

IIC1—11 to 45 inches, white (10YR 8/2) fine sand and sand, light brownish gray (10YR 6/2) when moist; few, medium, distinct, reddish-brown mottles; single grain; loose; moderately alkaline; clear, wavy boundary.

IIC2—45 to 72 inches, light-gray (2.5Y 7/2) fine sand, light brownish gray (2.5Y 6/2) when moist; few, fine, faint, dark reddish-brown mottles; single grain; loose; moderately alkaline.

The A horizon ranges from silt loam to loamy sand in texture and from 7 to 10 inches in thickness. The AC horizon ranges from silt loam to loamy sand in texture and from 3 to 10 inches in thickness. The IIC horizon is at a depth of 10 to 20 inches.

Boel soils are associated with Ord and Inavale soils. They have fine sand at a depth of 10 to 20 inches, and Ord soils have fine sand at a depth of 20 to 40 inches. Boel soils are wetter than Inavale soils because they have a higher water table.

Boel loamy fine sand (0 to 2 percent slopes) (Boa).—This soil occupies irregularly shaped tracts 3 to 100 acres in size on the bottom land in the Loup River Valleys. It has a surface layer of loamy fine sand, but otherwise its profile is similar to that described as representative for the Boel series. In cultivated areas the surface layer is loamy fine sand or loamy sand.

Included in mapping are small areas of Boel fine sandy loam and Inavale fine sand.

Runoff is slow. Soil blowing is a hazard on unprotected fields. The main limitation is the moderately high water table that delays seedbed preparation early in spring. The low available water capacity is a concern in management. Maintaining a high level of fertility is also a management need.

Most of the acreage is used for range or hay. In some areas next to the rivers, trees are the dominant vegetation. The other areas are used for cultivated crops. Corn, sorghum, and alfalfa are the main crops. Spring-sown small grain is not well suited, because the water table is moderately high early in spring. Capability unit IIIw–5 dryland, IIIw–5 irrigated; Subirrigated range site; Moderately Wet windbreak group.

Boel fine sandy loam (0 to 2 percent slopes) (Bob).—This soil is in 3- to 50-acre, irregularly shaped tracts on bottom land. It has the profile described as representative for the series. In cultivated areas the surface layer ranges from fine sandy loam to sandy loam.

Included in mapping are small areas of Boel loam and Ord fine sandy loam.

Surface runoff is slow. Soil blowing is a hazard on unprotected fields. The main limitation is the moderately high water table that delays seedbed preparation early in spring. The main concern in management is the low available water capacity. Maintaining a high level of fertility is also a management need.

Most of the acreage is used for range or hay. In some areas next to the rivers, trees are the dominant vegetation. Corn, sorghum, and alfalfa are the main crops. This soil is suited to other less intensive uses. Capability unit IIIw–6 dryland, IIw–61 irrigated; Subirrigated range site; Moderately Wet windbreak group.

Boel loam (0 to 2 percent slopes) (Boc).—This soil is in irregularly shaped tracts on bottom land in the valleys of the Loup River. Areas range from 3 acres to several hundred acres in size. The surface layer is dominantly loam; in small areas it is silt loam to very fine sandy loam. Otherwise, the profile of this soil is similar to the one described as representative for the series.

Included in mapping are small areas of Ord loam, Boel fine sandy loam, and small areas of Inavale fine sand, which are shown on the map by spot symbols.

Runoff is slow. The main limitation on this soil is the moderately high water table that delays seedbed preparation early in spring. Low available water capacity is the main management concern.

Most of the acreage is used for range or hay. In some areas next to the river, trees are the dominant vegetation. A small acreage is cultivated. Corn, sorghum, and alfalfa are the main crops. This soil is also suited to other less intensive uses. Capability unit IIw–4 dryland, IIw–4 irrigated; Subirrigated range site; Moderately Wet windbreak group.

Boelus Series

The Boelus series consists of deep, well-drained, nearly level to gently sloping soils on stream terraces along the Middle Loup River. These soils formed in eolian sand and loess.

In a representative profile, the surface layer is dark-gray loamy fine sand about 10 inches thick. The transitional layer is grayish-brown loamy fine sand about 9 inches thick. The subsoil is slightly hard, pale-brown silt loam about 18 inches thick. The underlying material is very pale brown silt loam. It has reddish-brown mottles in the lower part.

Boelus soils are neutral in the surface layer and subsoil, and they are moderately alkaline in the underlying material. Permeability is moderate, available water capacity is high, and natural fertility is medium.

These soils are suited to cultivated crops and range. They are suited to most locally grown crops. Most of the acreage is cultivated.

The Boelus soils in Howard County are mapped only with Libory soils.

Representative profile of Boelus loamy fine sand in area of Libory-Boelus loamy fine sands in a native grass pasture, 200 feet north and 0.14 mile west of the center of sec. 34, T. 13 N., R. 9 W.:

A11—0 to 10 inches, dark-gray (10YR 4/1) loamy fine sand, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure; soft when dry, very friable when moist; neutral; abrupt, smooth boundary.

A12—10 to 19 inches, grayish-brown (10YR 5/2) loamy fine sand, dark grayish brown (10YR 4/2) when moist; weak, medium, subangular blocky structure parting to weak, fine, granular; soft when dry, very friable when moist; neutral; abrupt, wavy boundary.

IIB2b—19 to 31 inches, pale-brown (10YR 6/3) silt loam, brown (10YR 5/3) when moist; weak, medium, prismatic structure parting to weak, medium, subangular blocky; slightly hard when dry, friable when moist; neutral; clear, wavy boundary.

IIB3b—31 to 37 inches, pale-brown (10YR 6/3) silt loam, brown (10YR 5/3) when moist; weak, coarse, subangular blocky structure parting to weak, medium, subangular blocky; slightly hard when dry, friable when moist; neutral; gradual, wavy boundary.

IIC—37 to 60 inches, very pale brown (10YR 7/3) silt loam, yellowish brown (10YR 5/4) when moist; massive; soft when dry, very friable when moist; calcareous, moderately alkaline; few, fine, reddish-brown iron stains.

The A11 horizon ranges from loamy fine sand to fine sand in texture and from 7 to 14 inches in thickness. It is dark gray to dark grayish brown. The A12 horizon is grayish-brown to brown loamy fine sand to fine sand 5 to 16 inches thick. The IIB2b horizon is loam to silty clay loam 12 to 24 inches thick. The IIC horizon is at a depth of 24 to 54 inches. In most areas the underlying material becomes coarse textured below a depth of 6 feet.

Boelus soils are associated with Libory and Loretto soils. In comparison with Libory soils, they have a brownish, instead of a mottled gray, C horizon and are well drained instead of moderately well drained. In comparison with Loretto soils, they have a coarser textured A12 horizon.

Coly Series

The Coly series consists of deep, well-drained to somewhat excessively drained, moderately sloping to steep soils on uplands. These soils formed in Peoria Loess.

In a representative profile, the surface layer is dark grayish-brown silt loam about 5 inches thick. The transitional layer is grayish-brown, slightly hard silt loam about 4 inches thick. The underlying material is very pale brown silt loam that contains a few, distinct, reddish-brown iron stains.

Coly soils are mildly alkaline in the surface layer and moderately alkaline and calcareous in the transitional layer and underlying material. Permeability is moderate, available water capacity is high, and natural fertility is low.

These soils are highly susceptible to erosion if they are cultivated. The moderate slopes are suited to limited cultivated crops, and the steep slopes are well suited to native grass.

Representative profile of Coly silt loam, 11 to 31 percent slopes, in a native pasture, 60 feet south and a quarter mile west of the northeast corner of sec. 5, T. 16 N., R. 10 W.:

A1—0 to 5 inches, dark grayish-brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure; slightly hard when dry, friable when moist; mildly alkaline; clear, smooth boundary.

AC—5 to 9 inches, grayish-brown (10YR 5/2) silt loam, dark grayish brown (10YR 4/2) when moist; weak, medium, subangular blocky structure parting to weak, fine, subangular blocky; slightly hard when dry, friable when moist; calcareous, moderately alkaline; clear, wavy boundary.

C—9 to 60 inches, very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) when moist; massive; soft when dry; very friable when moist; calcareous, moderately alkaline; few, distinct, reddish-brown iron stains.

The A1 horizon ranges from dark grayish brown to grayish brown in color and from 2 to 6 inches in thickness. It is calcareous in many places. The AC horizon ranges from 2 to 6 inches in thickness and from grayish brown to light brownish gray in color. The C horizon ranges from very pale brown to pale brown.

Coly soils are associated with Holder and Uly soils. They have a thinner A horizon than Holder and Uly soils, and lime is higher in their profile. They do not have the well-developed B horizon that is typical of Holder soils.

Coly silt loam, 5 to 11 percent slopes (CbC).—This soil occupies irregularly shaped tracts in the loess uplands on narrow ridges between drainageways and on slopes along drainageways. The areas range from 3 acres to several hundred acres in size. This soil has a lighter colored surface layer than that in the profile described as representative for the series. Most of the original dark-colored surface layer has been removed by water erosion. There are lime concretions on the surface.

Included in mapping are small areas of Uly silt loam, 5 to 11 percent slopes, and Holder silty clay loam, 5 to 11 percent slopes, severely eroded.

The soil is well drained. Surface runoff is medium, and the organic-matter content is low. Water erosion is the main hazard. Maintaining good tilth and fertility and conserving water are the chief management needs.

Nearly all the acreage is used for cultivated crops or is reseeded to native grass. Corn, sorghum, and alfalfa are the main crops. Reseeded areas should be left in native grass. This soil is also suited to trees and other less intensive uses. Capability unit IVe–8 dryland; Limy Upland range site; Silty to Clayey windbreak group.

Coly silt loam, 11 to 31 percent slopes (CbD).—This soil is in irregularly shaped areas around upland drainageways. Areas range from 3 acres to 150 acres in size. This soil has the profile described as representative for the series, but in cultivated areas it is eroded, the surface layer is lighter colored, and there are lime concretions on the surface.

Included in mapping are small areas of Nuckolls soils, 15 to 31 percent slopes, severely eroded.

This soil is excessively drained. Runoff is rapid, and the hazard of erosion is severe. The organic-matter content is low.

This soil is best suited to native grass. Most of the acreage is cultivated, but many areas have been reseeded to native grass. Because of steep slopes, rapid runoff, and the severe hazard of water erosion, this soil is not well suited to cultivated crops. It is suited to trees and other less intensive uses. Capability unit VIe–8 dryland; Limy Upland range site; Silty to Clayey windbreak group.

Coly-Uly complex, 15 to 31 percent slopes (CUD).—This mapping unit is about 55 percent Coly silt loam, 30 percent Uly silt loam, and 15 percent Hobbs and Nuckolls soils. These soils occupy areas adjacent to upland drainageways. Their profiles are similar to those described as representative for their respective series. Coly soils have slopes of 20 to 31 percent, and Uly soils 15 to 20 percent.

Unless protected, these soils are highly susceptible to water erosion. Runoff is rapid.

The soils are not suited to cultivated crops, but are suited to trees and other less intensive uses. Nearly all the acreage is in native grass and is used for grazing or hay. Capability unit VIe–9 dryland; Coly soil in Limy Upland range site, Uly soil in Silty range site; Silty to Clayey windbreak group.

Darr Series

The Darr series consists of well-drained, nearly level soils that are moderately deep over coarse-textured material. These soils occupy bottom land in the Loup River Valleys. They formed in loamy and sandy alluvium.

In a representative profile, the surface layer is dark grayish-brown fine sandy loam about 10 inches thick. The underlying material is soft sandy loam about 14 inches thick. It is light brownish gray in the upper 8 inches and light gray in the lower 6 inches. Below the underlying material is light-gray coarse sand.

Darr soils are neutral in the surface layer and the upper part of the underlying material and moderately alkaline in the lower part. Permeability is moderately rapid, available water capacity is low, and fertility is medium.

These soils are suited to cultivated crops and range. Most locally grown crops are suited. Most of the acreage is used for cultivated crops, and the rest is used for range. Part of the acreage is irrigated.

Representative profile of Darr fine sandy loam in a native grass pasture, 0.3 mile east and 0.3 mile north of the southwest corner of sec. 23, T. 13 N., R. 11 W.:

A—0 to 10 inches, dark grayish-brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, subangular blocky structure parting to weak, very fine, granular; soft when dry, very

friable when moist; neutral; abrupt, smooth boundary.

AC—10 to 12 inches, grayish-brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) when moist; weak, coarse, subangular blocky structure parting to weak, fine, subangular blocky; soft when dry, very friable when moist; neutral; clear, wavy boundary.

C1—12 to 20 inches, light brownish-gray (2.5Y 6/2) sandy loam, grayish brown (2.5Y 5/2) when moist; weak, coarse, subangular blocky structure parting to weak, fine, subangular blocky; soft when dry, very friable when moist; neutral; clear, wavy boundary.

C2—20 to 26 inches, light-gray (2.5Y 7/2) sandy loam, light brownish gray (2.5Y 6/2) when moist; weak, coarse, subangular blocky structure parting to weak, fine, subangular blocky; soft when dry, very friable when moist; calcareous, moderately alkaline; clear, wavy boundary.

IIC—26 to 60 inches, light-gray (10YR 7/2) coarse sand, light brownish gray (10YR 6/2) when moist; few, medium, faint, reddish-brown mottles; single grain; loose; moderately alkaline.

The A horizon ranges from dark grayish brown to grayish brown in color, from silt loam to sandy loam in texture, and from 10 to 18 inches in thickness. The AC horizon ranges from 2 to 6 inches in thickness and from grayish brown to light brownish gray in color. The IIC horizon is at a depth of 20 to 40 inches. In some areas it contains thin strata of medium-textured material.

Darr soils are associated with Inavale, Ord, and Boel soils. They have a finer textured C horizon than Inavale soils, and the water table is at a greater depth than in Ord or Boel soils.

Darr fine sandy loam (0 to 1 percent slopes) (Da).—This soil occupies irregularly shaped tracts 3 to 50 acres in size on the Loup River bottom land. It has the profile described as representative for the series. In cultivated areas the surface layer ranges from fine sandy loam to sandy loam.

Included in mapping are small areas of Inavale fine sandy loam and Darr silt loam.

Surface runoff is slow. Soil blowing is a hazard on unprotected fields. The main management concern is the low available water capacity. Maintaining fertility is also a management need.

Most of the acreage is used for cultivated crops. Part is irrigated. Corn, sorghum, and alfalfa are the main crops. The rest of the acreage is in native grass and is used for grazing or hay. This soil is also suited to trees and other less intensive uses. Capability unit IIe–3 dryland, IIe–3 irrigated; Sandy Lowland range site; Sandy windbreak group.

Darr silt loam (0 to 1 percent slopes) (Db).—This soil occupies irregularly shaped tracts 3 to 75 acres in size on the Loup River bottom land. It has a profile similar to the one described as representative for the series, but it has a silt loam surface layer.

Included in mapping are small areas of Inavale loam and Darr fine sandy loam, and some small areas of Inavale fine sand that are shown on the map by a sand spot symbol.

Runoff is slow. Low available water capacity and low fertility are the chief management concerns.

Most of the acreage is used for cultivated crops. Much of it is irrigated. Corn, sorghum, and alfalfa are the main crops.

This soil is also suited to grass and trees and to other less intensive uses. Capability unit I–1 dryland, I–1 irrigated; Sandy Lowland range site; Silty to Clayey windbreak group.

Detroit Series

The Detroit series consists of deep, moderately well drained, nearly level soils on stream terraces along rivers and creeks. These soils formed in alluvium and loess.

In a representative profile, the surface layer is dark-gray about 12 inches thick. It is silt loam in the upper 5 inches and silty clay loam in the lower 7 inches. The subsoil is dark gray and about 40 inches thick. It is about as dark as the surface layer. The upper 19 inches of the subsoil is very hard silty clay, and the lower 21 inches is hard silty clay loam that has an accumulation of lime. The underlying material is pale-brown silt loam that contains distinct, dark reddish-brown mottles.

Detroit soils are neutral in the surface layer, mildly alkaline in the upper subsoil, moderately alkaline and calcareous in the lower subsoil, and moderately alkaline in the underlying material. Permeability is slow, available water capacity is high, and natural fertility is high.

These soils are suited to cultivated crops and range. They are suited to all locally grown crops. Most of the acreage is cultivated.

Representative profile of Detroit silt loam, 0 to 1 percent slopes, in a cultivated field, 100 feet west and a quarter mile south of the northeast corner of sec. 16, T. 14 N., R. 12 W.:

Ap—0 to 5 inches, dark-gray (10YR 4/1) silt loam, very dark gray (10YR 3/1) when moist; weak, medium, subangular blocky structure parting to weak, fine, granular; slightly hard when dry, friable when moist; neutral; abrupt, smooth boundary.

A12—5 to 12 inches, dark-gray (10YR 4/1) silty clay loam, very dark gray (10YR 3/1) when moist; weak, coarse, subangular blocky structure parting to weak, fine, granular; hard when dry, friable when moist; neutral; clear, smooth boundary.

B21t—12 to 18 inches, dark-gray (10YR 4/1) silty clay, very dark brown (10YR 2/2) when moist; strong, coarse, prismatic structure parting to strong, fine, subangular blocky; very hard when dry, very firm when moist; thin clay films; mildly alkaline; clear, smooth boundary.

B22t—18 to 31 inches, dark-gray (10YR 4/1) silty clay, very dark brown (10YR 2/2) when moist; strong, coarse, prismatic structure parting to strong, medium, angular blocky; very hard when dry, very firm when moist; moderately alkaline; clear, smooth boundary.

B23ca—31 to 38 inches, dark-gray (10YR 4/1) silty clay loam, very dark grayish brown (10YR 3/2) when moist; moderate, coarse, subangular blocky structure parting to moderate, medium, subangular blocky; hard when dry, firm when moist; calcareous, moderately alkaline; gradual, wavy boundary.

B3ca—38 to 52 inches, dark-gray (10YR 4/1) silty clay loam, very dark grayish brown (10YR 3/2) when moist; weak, medium, subangular blocky structure; hard when dry, friable when moist; calcareous, moderately alkaline; gradual, wavy boundary.

C—52 to 60 inches, pale-brown (10YR 6/3) silt loam, dark brown (10YR 4/3) when moist; massive; hard when dry, friable when moist; calcareous, moderately alkaline; few, fine, distinct, dark reddish-brown iron stains.

The A horizon ranges from dark gray to dark grayish brown in color and from 10 to 18 inches in thickness. The B horizon ranges from 26 to 42 inches in thickness. The depth to the B23ca horizon ranges from 24 to 40 inches. The C ho-

rizon ranges from pale brown to brown or light yellowish brown.

Detroit soils are associated with Hall and Hord soils. They have a more clayey B horizon than those soils.

Detroit silt loam, 0 to 1 percent slopes (De).—This soil occupies slightly concave tracts on stream terraces. Areas are 3 to 75 acres in size.

Included in mapping are small areas of Hall silt loam, 0 to 1 percent slopes.

Surface runoff is slow. This soil is occasionally flooded by runoff from higher ground, but flooding is usually of short duration and rarely harms crops. Permeability is slow in the subsoil. The subsoil is sticky when wet.

Nearly all the acreage is cultivated. Some of it is irrigated. Corn, sorghum, and alfalfa are the main crops.

This soil is suited to grass, trees, and other less intensive uses. Capability unit IIs–2 dryland, IIs–2 irrigated; Silty Lowland range site; Silty to Clayey windbreak group.

Elsmere Series

The Elsmere series consists of deep, somewhat poorly drained, nearly level to very gently sloping soils on stream terraces and high bottom land south and east of the Middle Loup River. These soils formed in alluvial sand that had been reworked by wind. The water table fluctuates between depths of 2 and 6 feet.

In a representative profile, the surface layer is dark-gray loamy fine sand about 11 inches thick. The transitional layer is dark grayish-brown, soft loamy sand about 6 inches thick. It contains few, medium, distinct, reddish-brown mottles. The underlying material is light-gray fine sand in the upper 12 inches and light-gray sand below. The upper part has few, fine, distinct, reddish-brown mottles.

Elsmere soils are mildly alkaline in the surface layer and neutral in the transitional layer and underlying material. Permeability is rapid, available water capacity is low, and natural fertility is medium.

These soils are suited to range and cultivated crops. They are suited to most locally grown crops. Most of the acreage is cultivated. Because these soils are wet early in spring, they are not well suited to spring-sown small grain.

Representative profile of Elsmere loamy fine sand in a cultivated field, 100 feet north and 0.4 mile east of southwest corner of sec. 25, T. 13 N., R. 11 W.:

Ap—0 to 5 inches, dark-gray (10YR 4/1) loamy fine sand, very dark gray (10YR 3/1) when moist; weak, fine, granular structure; soft when dry, very friable when moist; calcareous, mildly alkaline; abrupt, smooth boundary.

A12—5 to 11 inches, dark-gray (10YR 4/1) loamy fine sand, very dark gray (10YR 3/1) when moist; weak, coarse, subangular blocky structure parting to weak, medium, subangular blocky; soft when dry, very friable when moist; calcareous, mildly alkaline; clear, smooth boundary.

AC—11 to 17 inches, dark grayish-brown (10YR 4/2) loamy sand, very dark grayish brown (10YR 3/2) when moist; few, medium, distinct, reddish-brown mottles; weak, coarse, subangular blocky structure parting to weak, medium, subangular blocky; soft when dry, very friable when moist; neutral; clear, smooth boundary.

C1—17 to 29 inches, light-gray (10YR 7/2) fine sand, grayish brown (10YR 5/2) when moist; few, fine, distinct, reddish-brown mottles; single grain; loose; neutral; gradual, wavy boundary.

C2—29 to 60 inches, light-gray (10YR 7/2) sand, light gray (2.5Y 6/2) when moist; single grain; loose; neutral.

The A horizon ranges from 7 to 12 inches in thickness. The Ap horizon ranges from loamy fine sand to loamy sand in texture and from dark gray to grayish brown in color. The AC horizon ranges from loamy sand to fine sand in texture and from 4 to 8 inches in thickness. The C horizon in many places contains thin strata of medium-textured material below a depth of 36 inches.

Elsmere soils are associated with Tryon, Ovina, and Valentine soils. They are better drained than Tryon soils and have a coarser textured C horizon than Ovina soils. The water table in Elsmere soils is higher than in Valentine soils.

Elsmere loamy fine sand (0 to 2 percent slopes) (Eo).—This soil occupies irregularly shaped tracts 5 to 100 acres in size on stream terraces and high bottom land.

Included in mapping are small areas of Valentine and Thurman soils, 0 to 17 percent slopes, and Tryon soils, drained.

Surface runoff is slow. Soil blowing is a hazard on unprotected fields. The main limitation is the moderately high water table that delays seedbed preparation early in spring. Low available water capacity is a management concern. Maintaining an adequate level of fertility is needed, particularly in irrigated areas.

Most of the acreage is cultivated. Some is irrigated. The rest is in native grass and is used for grazing. Corn, sorghum, and alfalfa are the main crops. The soil is not suited to small grain sown in spring because the water table is too high at that time. It is suited to grass, trees, and other less intensive uses. Capability unit IIIw–5 dryland, IIIw–5 irrigated; Subirrigated range site; Moderately Wet windbreak group.

Geary Series

The Geary series consists of deep, moderately sloping to strongly sloping, well-drained soils on uplands bordering the Loup River Valleys. These soils formed in slightly reddish loess that is older than Peoria Loess.

In a representative profile, the surface layer is brown silty clay loam about 5 inches thick. The subsoil is about 20 inches thick. The upper 12 inches of the subsoil is brown, hard silty clay loam. The lower 8 inches is light-brown, slightly hard silt loam. The underlying material is light-brown silt loam.

Geary soils are neutral in the surface layer and upper subsoil and mildly alkaline to moderately alkaline and calcareous in the lower subsoil and underlying material. Permeability is moderately slow, available water capacity is high, and fertility is low.

Most of the acreage is used for cultivated crops. Some is in native grass. The soils are suited to most locally grown crops.

Representative profile of a Geary silty clay loam in an area of Geary soils, 7 to 11 percent slopes, severely eroded, in bromegrass pasture, 120 feet north and 1,550 feet west of the southeast corner of sec. 10, T. 15 N., R. 10 W.:

Ap—0 to 5 inches, brown (10YR 5/3) silty clay loam, dark brown (10YR 4/3) when moist; weak, medium, subangular blocky structure parting to weak, fine, subangular blocky; very hard when dry, firm when moist; neutral; abrupt, smooth boundary.

B21t—5 to 11 inches, brown (10YR 5/3) silty clay loam, dark

brown (10YR 4/3) when moist; moderate, medium, prismatic structure parting to moderate, medium, angular blocky; hard when dry, firm when moist; neutral; clear, smooth boundary.

B22t—11 to 17 inches, brown (7.5YR 5/4) silty clay loam, dark brown (7.5YR 4/4) when moist; moderate, medium, prismatic structure parting to moderate, medium, subangular blocky; hard when dry, firm when moist; calcareous, mildly alkaline; clear, wavy boundary.

B3—17 to 25 inches, light-brown (7.5YR 6/4) silt loam, brown (7.5YR 5/4) when moist; weak, medium, prismatic structure parting to weak, medium, subangular blocky; slightly hard when dry, friable when moist; calcareous, moderately alkaline; clear, wavy boundary.

Cca—25 to 60 inches, light-brown (7.5YR 6/4) silt loam, brown (7.5YR 5/4) when moist; massive; slightly hard when dry, friable when moist; calcareous, moderately alkaline.

The Ap horizon ranges from silt loam to silty clay loam in texture and from 3 to 6 inches in thickness. The B horizon is 12 to 36 inches thick and has a clay content of 27 to 35 percent.

The Geary soils in Howard county are not within the range defined for the series. They have a lighter colored and thinner A horizon, they do not have clay films in the B22 horizon, and they are more alkaline than is defined in the range for the series. Erosion has removed up to three-fourths of the original surface layer. These differences, however, do not alter the usefulness or behavior of the soils.

Geary soils are associated with Coly, Uly, Holder, and Nuckolls soils. They are redder in the B3 and C horizons than Uly and Holder soils. They have more clay in the B horizon than Nuckolls soils.

Geary soils, 7 to 11 percent slopes, severely eroded (GsC3).—These soils are on ridgetops in uplands in areas 3 to 50 acres in size. They have the profile described as representative of the series. The surface layer generally is silty clay loam but ranges from silty clay loam to silt loam. Erosion has removed all of the original surface layer.

Included in mapping are small areas of Uly silt loam, 5 to 11 percent slopes.

Runoff is medium, and the organic-matter content and natural fertility are low. Water erosion is a severe hazard. The soils are deficient in nitrogen and phosphorus.

This unit is suited to cultivated crops if measures are taken to control erosion. Most of the acreage is cultivated. Corn, sorghum, and alfalfa are the main crops. The soils are also suited to grass, trees, and other less intensive uses. Capability unit IVe-8 dryland; Silty range site; Silty to Clayey windbreak group.

Geary soils, 11 to 15 percent slopes, severely eroded (GsD3).—This unit occupies ridgetops and slopes around drainageways in the uplands. It occurs as areas 3 to 50 acres in size. The surface layer is typically silty clay loam, but in places it is silt loam. Water erosion has removed all of the original surface layer.

Included in mapping are small areas of Uly silt loam, 11 to 15 percent slopes.

Runoff is rapid, and the organic-matter content and natural fertility are low. The soils are deficient in nitrogen and phosphorus.

These soils are not suited to cultivated crops because the erosion hazard is too severe. Most of the acreage is cultivated. Reseeding the acreage to native grass would be beneficial. These soils are also suited to trees and other less intensive uses. Capability unit VIe-8 dryland; Silty range site; Silty to Clayey windbreak group.

Gibbon Series

The Gibbon series consist of deep, somewhat poorly drained soils on low terraces and bottom lands in the Loup River Valleys. These soils formed in silty alluvium. The water table fluctuates between depths of 2 and 6 feet.

In a representative profile, the surface layer is very dark grayish-brown, slightly hard silt loam about 8 inches thick. The transitional layer is light brownish-gray, hard silt loam about 8 inches thick. The underlying material is light gray. The upper 27 inches is calcareous silt loam, and the lower part is very fine sandy loam that contains common, distinct, yellowish-brown mottles.

Gibbon soils are moderately alkaline throughout the profile. Permeability is moderate, available water capacity is high, and natural fertility is high.

These soils are suited to most locally grown cultivated crops and range grasses. Most of the acreage is cultivated. Spring-sown small grain is not well suited, because the water table is high early in spring.

Representative profile of Gibbon silt loam in a cultivated field, 100 feet north and 0.1 mile east of the southwest corner of sec. 24, T. 13 N., R. 11 W.:

Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) silt loam, black (10YR 2/1) when moist; weak, medium, granular structure parting to weak, very fine, granular; slightly hard when dry, friable when moist; calcareous, moderately alkaline; abrupt, smooth boundary.

AC—8 to 16 inches, light brownish-gray (2.5Y 6/2) silt loam, grayish brown (2.5Y 5/2) when moist; weak, coarse, subangular blocky structure parting to weak, fine, subangular blocky; hard when dry, friable when moist; calcareous, moderately alkaline; clear, smooth boundary.

C1—16 to 40 inches, light-gray (2.5Y 7/2) silt loam, grayish brown (2.5Y 5/2) when moist; weak, coarse, subangular blocky structure parting to weak, fine, subangular blocky; hard when dry, friable when moist; calcareous, moderately alkaline; clear, smooth boundary.

C2—40 to 43 inches, gray (5Y 6/1) silty clay loam, dark gray (5Y 4/1) when moist; massive; very hard when dry, firm when moist; moderately alkaline; clear, smooth boundary.

C3—43 to 60 inches, light-gray (2.5Y 7/2) very fine sandy loam, light brownish gray (2.5Y 6/2) when moist; common, medium, distinct, yellowish-brown mottles; massive; slightly hard when dry, very friable when moist; moderately alkaline; clear, smooth boundary.

The Ap horizon ranges from very fine sandy loam to silty clay loam in texture and from 7 to 18 inches in thickness. The AC horizon ranges from 6 to 14 inches in thickness and from very fine sandy loam to silty clay loam in texture. The C horizon ranges from very fine sandy loam to silty clay loam, and in some areas it is thinly stratified with sand. Fine sand is commonly at a depth below 4 feet.

Gibbon soils are associated with Lamo and Ord soils. They are less clayey in the C horizon than Lamo soils and are not so coarse textured as Ord soils.

Gibbon silt loam (0 to 2 percent slopes) (Gg).—This soil occupies irregularly shaped tracts 3 to 100 acres in size on bottom land and low stream terraces.

Included in mapping are small areas of Lamo silt loam and Ord loam and also small areas of Inavale fine sand, which are shown on the map by spot symbols.

A moderately high water table delays seedbed preparation early in spring. Runoff is slow. Surface drainage

is needed during wet periods to keep this soil in good tilth and at a high level of fertility.

This soil is suited to cultivated crops. Most of the acreage is cultivated. Some of it is is irrigated. Corn, sorghum, and alfalfa are the main crops. Spring-sown small grain is not well suited because the water table is high early in spring. The soil is also suited to grass, trees, and to other less intensive uses. Capability unit IIw-4 dryland, IIw-4 irrigated; Subirrigated range site; Moderately Wet windbreak group.

Grigston Series

The Grigston series consists of deep, well-drained soils on bottom land in the Loup River Valleys. These soils formed in silty alluvium.

In a representative profile, the surface layer is dark-gray loam about 10 inches thick. The subsoil is grayish-brown, hard light silty clay loam about 9 inches thick. The underlying material is light brownish-gray silt loam in the upper 22 inches, light silty clay loam in the next 7 inches, and silt loam below.

Grigston soils are neutral in the surface layer, mildly alkaline in the subsoil, and calcareous and moderately alkaline in the underlying material. Permeability is moderate, available water capacity is high, and fertility is high.

Grigston soils are well suited to all locally grown crops. Most of the acreage is cultivated. Some is in native grass.

Representative profile of Grigston silt loam in native grass pasture, 75 feet south and 0.1 mile west of the northeast corner of sec. 33, T. 16 N., R. 11 W.:

A—0 to 10 inches, dark-gray (10YR 4/1) silt loam, very dark brown (10YR 2/2) when moist; weak, medium, subangular blocky structure parting to weak, fine, granular; slightly hard when dry, friable when moist; neutral; clear, smooth boundary.

B2—10 to 19 inches, grayish-brown (2.5Y 5/2) light silty clay loam, dark grayish brown (2.5Y 4/2) when moist; weak, medium, subangular blocky structure parting to weak, fine, subangular blocky; hard when dry, friable when moist; mildly alkaline; gradual, wavy boundary.

C1ca—10 to 41 inches, light brownish-gray (2.5Y 6/2) silt loam, grayish brown (2.5Y 5/2) when moist; weak, medium, subangular blocky structure parting to weak, fine, subangular blocky; slightly hard when dry, friable when moist; calcareous, moderately alkaline; gradual, wavy boundary.

C2—41 to 48 inches, light brownish-gray (2.5Y 6/2) light silty clay loam, grayish brown (2.5Y 5/2) when moist; few, medium, faint, yellowish-red mottles; massive; hard when dry, friable when moist; moderately alkaline; clear, wavy boundary.

C3—48 to 60 inches, light brownish-gray (2.5Y 6/2) silt loam, grayish brown (2.5Y 5/2) when moist; massive; slightly hard when dry, friable when moist; moderately alkaline.

The A horizon ranges from 10 to 14 inches in thickness. The B2 horizon ranges from loam to light silty clay loam in texture and from 18 to 24 inches in thickness. The C horizon is at a depth of 18 to 38 inches. In places it is sandier at a depth of 4 to 8 feet.

Grigston soils are associated with Darr and Gibbon soils. They have a finer textured C horizon than Darr soils. They have a lower water table than Gibbon soils.

Grigston silt loam (0 to 1 percent slopes) (Gk).—This soil occupies irregularly shaped tracts on bottom land. Areas are 5 to 50 acres in size. Included in mapping are small areas of Darr silt loam.

Maintaining good tilth and a high level of fertility is the main management concern. Runoff is slow.

Most of the acreage is used for cultivated crops. Some is irrigated. Corn, sorghum, and alfalfa are the main crops. This soil is also suited to grass, trees, and other less intensive uses. Capability unit I-1 dryland, I-1 irrigated; Silty Lowland range site; Silty to Clayey windbreak group.

Hall Series

The Hall series consists of deep, well-drained soils on stream terraces along the river and creeks. These soils formed in a mixture of alluvium and loess.

In a representatife profile, the surface layer is dark gray and about 14 inches thick. The upper 6 inches is silt loam, and the lower 8 inches is light silty clay loam. The subsoil is hard silty clay loam about 31 inches thick. It is dark gray in the upper 15 inches and grayish brown in the lower 16 inches; the upper part is about as dark as the surface layer. The underlying material is light brownish-gray silt loam. It has an acumulation of lime.

Hall soils are slightly acid in the surface layer, neutral in the subsoil, and moderately alkaline in the underlying material. Permeability is moderately slow, available water capacity is high, and natural fertility is high.

Most areas of these soils are cultivated. The rest are in native grass. Both dryland and irrigated crops are well suited.

Representative profile of Hall silt loam, 0 to 1 percent slopes, in a cultivated field, 100 feet north and one-fourth mile west of the center of sec. 5, T. 13 N., R. 11 W.:

Ap—0 to 6 inches, dark-gray (10YR 4/1) silt loam, very dark brown (10YR 2/2) when moist; weak, fine, granular structure parting to weak; very fine, granular; slightly hard when dry, friable when moist; slightly acid; abrupt, smooth boundary.

A12—6 to 14 inches, dark-gray (10YR 4/1) light silty clay loam, very dark brown (10YR 2/2) when moist; weak, medium, granular structure parting to weak, very fine, granular; hard when dry, friable when moist; slightly acid; clear, smooth boundary.

B2t—14 to 29 inches, dark-gray (10YR 4/1) silty clay loam, very dark gray (10YR 3/1) when moist; moderate, coarse, prismatic structure parting to moderate, medium, subangular blocky; hard when dry, firm when moist; neutral; gradual, wavy boundary.

B3—29 to 45 inches, grayish-brown (2.5Y 5/2) silty clay loam, dark grayish brown (2.5Y 4/2) when moist; weak, coarse, prismatic structure parting to weak, medium, subangular blocky; slightly hard when dry, friable when moist; neutral; gradual, wavy boundary.

Cca—45 to 60 inches, light brownish-gray (2.5Y 6/2) silt loam, dark grayish brown (2.5Y 4/2) when moist; weak, coarse, prismatic structure or massive; slightly hard when dry, friable when moist; calcareous, moderately alkaline.

The A horizon ranges from 12 to 20 inches in thickness. The B horizon ranges from 24 to 40 inches in thickness. The B2t horizon has a clay content of 27 to 35 percent. In some areas, sand deposits and buried soils occur in the C horizon.

Hall soils are associated with Hord and Detroit soils. They have more clay in the B horizon than Hord soils and less clay in the B horizon than Detroit soils.

Hall silt loam, 0 to 1 percent slopes (Ha).—This soil occupies irregularly shaped tracts on stream terraces. Areas are 3 to 100 acres in size.

Included in mapping are small areas of Hord silt loam, 0 to 1 percent slopes; small areas of Detroit silt loam, 0 to 1 percent slopes; and areas where the surface layer has been altered by land leveling.

Runoff is slow. The main limitation in dryland areas is the lack of sufficient rainfall in most years. Maintaining good tilth and a high level of fertility is a management concern in both dryland and irrigated areas.

This soil is well suited to dryland and irrigated crops. Nearly all the acreage is cultivated, and much of it is irrigated. Corn, sorghum, and alfalfa are the main crops. The soil is also suited to grass, trees, and other less intensive uses. Capability unit IIc-1 dryland, I-11 irrigated; Silty Lowland range site; Silty to Clayey windbreak group.

Hastings Series

The Hastings series consists of deep, nearly level, well-drained soils on the upland flats west and north of the Middle Loup River. These soils formed in Peoria Loess.

In a representative profile, the surface layer is dark-gray silt loam about 10 inches thick. The subsoil is about 25 inches thick. The upper 6 inches is dark grayish-brown, hard silty clay loam. The middle part is grayish-brown, hard silty clay loam about 9 inches thick. The lower 10 inches is light brownish-gray, slightly hard silt loam, and the underlying material is pale-brown silt loam.

Hastings soils are slightly acid in the surface layer, neutral in the subsoil, and mildly alkaline to moderately alkaline and calcareous in the underlying material. Permeability is moderately slow, available water capacity is high, and natural fertility is high.

These soils are well suited to dryland and irrigated crops. Nearly all the acreage is cultivated, and many areas are irrigated. All locally grown crops are suited. Most of the acreage that is not cultivated is in range.

Representative profile of Hastings silt loam, 0 to 1 percent slopes, in a cultivated field, 170 feet west and 2,500 feet south of the northeast corner of sec. 29, T. 16 N., R. 10 W.

Ap—0 to 7 inches, dark-gray (10YR 4/1) silt loam, very dark brown (10YR 2/2) when moist; weak, fine, granular structure parting to weak, very fine, granular; slightly hard when dry, friable when moist; slightly acid; abrupt, smooth boundary.

A12—7 to 10 inches, dark-gray (10YR 4/1) silt loam, very dark brown (10YR 2/2) when moist; weak, fine, subangular blocky structure parting to weak, fine, granular; slightly hard when dry, friable when moist; slightly acid; clear, smooth boundary.

B1—10 to 16 inches, dark grayish-brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) when moist; weak, medium, subangular blocky structure parting to weak, fine, subangular blocky; hard when dry, firm when moist; neutral; clear, smooth boundary.

B2t—16 to 25 inches, grayish-brown (2.5Y 5/2) silty clay loam, dark grayish brown (2.5Y 4/2) when moist; moderate, medium, prismatic structure parting to moderate, medium, subangular blocky; hard when dry, firm when moist; neutral; clear, wavy boundary.

B3—25 to 35 inches, light brownish-gray (2.5Y 6/2) silt loam, grayish brown (2.5Y 5/2) when moist; weak, medium, prismatic structure parting to weak, fine, subangular blocky; slightly hard when dry, friable when moist; neutral; clear, wavy boundary.

C1—35 to 44 inches, pale-brown (10YR 6/3) silt loam, brown (10YR 5/3) when moist; weak, coarse, prismatic structure; soft when dry, very friable when moist; mildly alkaline; clear, wavy boundary.

C2—44 to 60 inches, pale-brown (10YR 6/3) silt loam, brown (10YR 5/3) when moist; massive; soft when dry, very friable when moist; calcareous, moderately alkaline.

The A horizon ranges from 10 to 14 inches in thickness. The B horizon ranges from 24 to 36 inches in thickness. The B2t horizon is 35 to 40 percent clay. The B3 horizon ranges from silt loam to silty clay loam. The depth to lime is 34 to 60 inches.

Hastings soils are associated with Holder and Coly soils. They have a more clayey B horizon than Holder soils. In contrast with Coly soils, they have a B horizon and a thicker A horizon and are deeper over lime.

Hastings silt loam, 0 to 1 percent slopes (Hs).—This soil occupies irregularly shaped tracts on upland flats. Areas range in size from 10 acres to several hundred acres.

Included in mapping are small depressions that are shown on the map by a depression spot symbol; areas of Holder silt loam, 0 to 1 percent slopes; and areas where the surface layer has been altered by land leveling.

The main limitation in dryland areas is the lack of sufficient rainfall in most years. Maintaining good tilth and high fertility is a management concern in both dryland and irrigated areas. Runoff is slow.

The soil is well suited to dryland and irrigated crops. Nearly all the acreage is cultivated, and much of it is irrigated. Corn, sorghum, and alfalfa are the main crops. The soil is also suited to grass, trees, and other less intensive uses. Capability unit IIc-1 dryland, I-11 irrigated; Silty range site; Silty to Clayey windbreak group.

Hobbs Series

The Hobbs series consists of deep, well-drained soils on colluvial foot slopes at the base of hills and on bottom land along creeks and narrow upland drainageways. These soils formed in silty alluvium and loess.

In a representative profile, the surface layer is dark gray and about 25 inches thick. The upper 5 inches is silt loam, and the next 6 inches is silty clay loam. The lower part is slightly hard silt loam. The underlying material is light brownish-gray silt loam.

Hobbs soils are neutral throughout the profile. Permeability is moderate, available water capacity is high, and natural fertility is high.

These soils are well suited to cultivated crops and range. They are suited to locally grown crops. Most of the acreage is cultivated, and most of it is irrigated. Small areas are in native grass.

Representative profile of Hobbs silt loam, 0 to 1 percent slopes, in a cultivated field, 100 feet south and 0.4 mile east of the northwest corner of sec. 35, T. 14 N., R. 11 W.:

Ap—0 to 5 inches, dark-gray (10YR 4/1) silt loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure; hard when dry, friable when moist; neutral; abrupt, smooth boundary.

A12—5 to 11 inches, dark-gray (10YR 4/1) light silty clay loam, very dark brown (10YR 2/2) when moist; weak, coarse, subangular blocky structure parting to weak, fine, granular; hard when dry, friable when moist; neutral; clear, smooth boundary.

A13—11 to 25 inches, dark-gray (10YR 4/1) silt loam, black (10YR 2/1) when moist; weak, coarse, subangular blocky structure parting to weak, fine, subangular blocky; slightly hard when dry, friable when moist; neutral; gradual, wavy boundary.

C—25 to 60 inches, light brownish-gray (2.5Y 6/2) silt loam, dark grayish brown (2.5Y 4/2) when moist; weak, coarse, subangular blocky structure; slightly hard when dry, friable when moist; neutral.

The A horizon ranges from 20 to 30 inches in thickness. In the upland drainageways it is stratified with material that is dark gray to grayish brown and 5 to 10 inches thick. In some areas there is a buried soil at a depth of 3 to 5 feet. These soils are typically stratified with light- and dark- colored lenses throughout the profile. They are normally well drained, but upland drainageways overflow after intense rain. Damage to crops is generally not severe.

Hobbs soils are associated with Hord, Grigston, and Gibbon soils. They are more stratified than Hord soils. They have a thicker A horizon than Grigston soils. They have a lower water table than Gibbon soils.

Hobbs silt loam, 0 to 1 percent slopes (Hb).—This soil occupies irregularly shaped tracts on bottom land along narrow upland drainage ways. Areas are 50 to several hundred acres in size. This soil has the profile described as representative for the series.

Included in mapping are small areas of Grigston silt loam, Hobbs silt loam, occasionally flooded, and Hord silt loam, 0 to 1 percent slopes.

Runoff is slow. Maintaining good tilth and high fertility is a management concern.

This soil is well suited to both dryland and irrigated crops. Nearly all the acreage is cultivated; much of it is irrigated. Corn, sorghum, and alfalfa are the main crops. This soil is also suited to grass, trees, and other less intensive uses. Capability unit I–1 dryland, I–1 irrigated; Silty Lowland range site; Silty to Clayey windbreak group.

Hobbs silt loam, occasionally flooded (0 to 1 percent slopes) (2Hb).—This soil occupies oblong tracts 3 acres to several hundred acres in size along narrow upland drains. It has a profile similar to the one described as representative for the series, but the surface layer is more stratified. The soil is occasionally flooded after heavy rain, but flooding is of short duration.

Included in mapping are small areas of Hobbs silt loam, 0 to 1 percent slopes.

The main hazard is the occasional flooding, which seldom causes a total crop loss, but at times delays tillage or makes reseeding necessary. Maintaining good tilth and fertility is a management concern. Runoff is medium.

This soil is suited to cultivated crops. Nearly all the acreage is cultivated, and some of it is irrigated. Corn and sorghum are the main crops. Small grain and alfalfa are not so well suited as row crops because of occasional flooding. The soil is also suited to grass, trees, and other less intensive uses. Capability unit IIw–3 dryland, I–12 irrigated; Silty Overflow range site; Moderately Wet windbreak group.

Hobbs silt loam, 1 to 3 percent slopes (HbA).—This soil occupies oblong and irregularly shaped tracts 3 acres to 100 acres in size on stream terraces and foot slopes.

Included in mapping are small areas of Hord silt loam, 0 to 1 percent slopes, and Hobbs silt loam, 3 to 5 percent slopes.

Runoff is medium. Water erosion is a slight hazard. Maintaining good tilth and fertility is a management concern.

This soil is well suited to cultivated crops, both dryland and irrigated. Nearly all the acreage is cultivated, and much of it is irrigated. Corn, sorghum, and alfalfa are the main crops. The soil is also suited to grass, trees, and other less intensive uses. Capability unit IIe–1 dryland, IIe–1 irrigated; Silty Lowland range site; Silty to Clayey windbreak group.

Hobbs silt loam, 3 to 5 percent slopes (HbB).—This soil occupies oblong and irregularly shaped tracts 3 to 75 acres in size on stream terraces and foot slopes. This soil has a profile similar to that described as representative for the series, but in areas that have been leveled the surface layer is thinner.

Included in mapping are small areas of Hobbs silt loam, 1 to 3 percent slopes.

Runoff is medium. Water erosion is a hazard on unprotected fields. Maintaining good tilth and fertility is a management concern.

This soil is well suited to cultivated crops, both dryland and irrigated. Nearly all the acreage is cultivated, and much of it is irrigated. Corn, sorghum, and alfalfa are the main crops. This soil is also suited to grass, trees, and other less intensive uses. Capability unit IIe–11 dryland, IIIe–1 irrigated; Silty Lowland range site; Silty to Clayey windbreak group.

Holder Series

The Holder series consists of deep, well-drained, nearly level to sloping soils on uplands west and north of the Middle Loup River. These soils formed in Peoria Loess.

In a representative profile, the surface layer is silt loam about 13 inches thick. The upper 5 inches is very dark grayish brown, and the lower 8 inches is dark grayish brown. The subsoil is about 31 inches thick. It is grayish-brown, hard, light silty clay loam in the upper 10 inches; brown, hard, light silty clay loam in the middle 16 inches; and pale-brown, slightly hard silt loam in the lower 5 inches. The underlying material is very pale brown silt loam.

Holder soils are slightly acid in the upper part of the surface layer, neutral in the lower part of the surface layer and the upper part of the subsoil, mildly alkaline in the lower part of the subsoil, and moderately alkaline and calcareous in the underlying material. Permeability is moderately slow, available water capacity is high, and natural fertility is high except in eroded areas.

Holder soils are well suited to dryland and irrigated crops. Nearly all the acreage is cultivated, and many acres are irrigated. Part of the acreage is in range.

Representative profile of Holder silt loam, 1 to 3 percent slopes, in a cultivated field, 0.2 mile south and 0.25 mile west of the northeast corner of sec. 9, T. 16 N., R. 9 W.:

Ap—0 to 5 inches, very dark grayish-brown (10YR 3/2) silt loam, very dark brown (10YR 2/2) when moist, weak, fine, granular structure parting to weak, very fine, granular; slightly hard when dry, friable when moist; slightly acid; abrupt, smooth boundary.

A12—5 to 13 inches, dark grayish-brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) when moist; weak, medium, subangular blocky structure parting to weak, fine, granular; slightly hard when dry, friable when moist; neutral; clear, wavy boundary.

B21t—13 to 23 inches, grayish-brown (10YR 5/2) light silty clay loam, dark grayish brown (10YR 4/2) when moist; moderate, medium, subangular blocky structure parting to moderate, fine, subangular blocky; hard when dry, firm when moist; neutral; clear, wavy boundary.

B22t—23 to 39 inches, brown (10YR 5/3) light silty clay loam, dark brown (10YR 4/3) when moist; moderate, medium, prismatic structure parting to moderate, medium, subangular blocky; hard when dry, firm when moist; neutral; clear, wavy boundary.

B3—39 to 44 inches, pale-brown (10YR 6/3) silt loam, brown (10YR 5/3) when moist; weak, medium, subangular blocky structure parting to weak, fine, subangular blocky; slightly hard when dry, friable when moist; mildly alkaline; clear, wavy boundary.

C—44 to 60 inches, very pale brown (10YR 7/3) silt loam, pale brown (10YR 6/3) when moist; weak, coarse, prismatic structure; soft when dry, very friable when moist; calcareous, moderately alkaline.

The A horizon ranges from silt loam to silty clay loam and is 8 to 14 inches thick. The B horizon is 16 to 36 inches thick. The B2t horizon is 27 to 35 percent clay. The depth to lime is 36 to 50 inches.

Holder soils are associated with Hastings, Uly, and Coly soils. They differ from Coly soils in having a B horizon. They have less clay in the subsoil than Hastings soils. They have more clay in the B horizon than Uly soils.

Holder silt loam, 0 to 1 percent slopes (Hg).—This soil occupies irregularly shaped tracts 5 acres to several hundred acres in size on upland flats.

Included in mapping are small areas of Hastings silt loam, 0 to 1 percent slopes; small depressions that are shown on the map by a depression spot symbol; and areas where the surface layer has been altered by land leveling.

Runoff is slow. In most years the main limitation for dryland crops is insufficient rainfall. Maintaining good tilth and high fertility is the main management concern in both irrigated and dryland areas.

This soil is well suited to cultivated crops, both dryland and irrigated. Nearly all the acreage is cultivated, and much of it is irrigated. This soil is also suited to grass and trees and to use as wildlife habitat. Capability unit IIc-1 dryland, I-11 irrigated; Silty range site; Silty to Clayey windbreak group.

Holder silt loam, 1 to 3 percent slopes (HgA).—This soil occupies irregularly shaped areas 5 acres to several hundred acres in size on uplands. It has the profile described as representative for the series.

Included in mapping are small areas of Holder silt loam, 0 to 1 percent slopes; Holder silt loam, 3 to 5 percent slopes, eroded; and areas where the surface layer has been altered by land leveling.

Runoff is slow. Water erosion is a hazard. Maintaining good tilth and a high level of fertility is the chief concern in management.

This soil is well suited to cultivated crops, both dryland and irrigated. Nearly all the acreage is cultivated, and most of it is irrigated. Corn, sorghum, and alfalfa are the main crops. This soil is also suited to grass, trees, and other less intensive uses. Capability unit IIe-1 dryland, IIe-1 irrigated; Silty range site; Silty to Clayey windbreak group.

Holder silt loam, 3 to 5 percent slopes, eroded (HgB2).—This soil occupies irregularly shaped tracts 5 acres to several hundred acres in size on upland ridges. It has a profile similar to the one described as representative for the series, but the surface layer is eroded and about 4 inches thinner.

Included in mapping are small areas of Holder silt loam, 1 to 3 percent slopes, and areas where the surface layer has been altered by land leveling.

Runoff is medium. Water erosion is the main hazard. Maintaining good tilth and a high level of fertility is a concern in management.

This soil is suited to cultivated crops, both dryland and irrigated. Most of the acreage is cultivated, and much of it is irrigated. Corn, sorghum, and alfalfa are the main crops. This soil is also suited to grass, trees, and other less intensive uses. Capability unit IIe-11 dryland, IIIe-1 irrigated; Silty range site; Silty to Clayey windbreak group.

Holder silt loam, 5 to 11 percent slopes (HgC).—This soil occupies hillsides and ridges on uplands. Areas are 3 to 100 acres in size.

Included in mapping are small areas of Uly silt loam, 5 to 11 percent slopes, and Holder silty clay loam, 5 to 11 percent slopes, eroded.

Runoff is medium. Water erosion is a hazard in cultivated areas. Good tilth and a high level of fertility must be maintained.

Nearly all the acreage is in native grass and is used for range. Some is in cultivated crops. Corn, sorghum, and alfalfa are the main crops. This soil is also suited to grass, trees, and other less intensive uses. Capability unit IIIe-1 dryland, IVe-1 irrigated; Silty range site; Silty to Clayey windbreak group.

Holder silty clay loam, 5 to 11 percent slopes, eroded (HpC2).—This soil occupies hillsides and ridges on uplands. Areas are 3 acres to 100 acres in size. This soil has a profile similar to the one described as representative for the series, but erosion has removed a fourth to half of the original surface layer. The present surface layer is silty clay loam 7 to 9 inches thick. In some cultivated areas, the subsoil is exposed.

Included in mapping are small areas of Holder silty clay loam, 5 to 11 percent slopes, severely eroded.

Runoff is medium. Water erosion is a hazard. Good tilth and high level of fertility must be maintained.

All the acreage is cultivated or has been cultivated. Some is irrigated. Some areas have been reseeded to grass. Corn, sorghum, and alfalfa are the main crops. This soil is also suited to grass, trees, and other less intensive uses. Capability unit IIIe-1 dryland, IVe-1

irrigated; Silty range site; Silty to Clayey windbreak group.

Holder silty clay loam, 5 to 11 percent slopes, severely eroded (HpC3).—This soil occupies irregularly shaped tracts 3 acres to several hundred acres in size on ridgetops and upper parts of slopes on uplands. It has a profile similar to the one described as representative for the series, but erosion has removed most or all of the original surface layer. The present surface layer is silty clay loam. It is thinner and lighter colored than is defined in the range for the series. In some areas it is 5 inches thick, but in many areas the subsoil is exposed. The subsoil is 10 to 20 inches thick. This soil is calcareous at the surface in most areas.

Included in mapping are small areas of Holder silty clay loam, 5 to 11 percent slopes, eroded, and Coly silt loam, 5 to 15 percent slopes.

Runoff is medium. Fertility is very low, and the organic-matter content is low. Water erosion is a serious hazard. Improving tilth and fertility is a management concern. This soil is deficient in nitrogen and phosphorus.

All the acreage is used for cultivated crops or has been reseeded to native grass. Corn, sorghum, and alfalfa are the main crops. This soil is also suited to trees and other less intensive uses. Capability unit IVe–81 dryland, IVe–11 irrigated; Silty range site; Silty to Clayey windbreak group.

Hord Series

The Hord series consists of deep, well-drained, nearly level soils on stream terraces along the rivers and creeks. These soils formed in silty alluvium and loess (fig. 6).

In a representative profile, the surface layer is dark-gray silt loam about 20 inches thick. The subsoil is about 19 inches thick. It is grayish-brown, hard, light silty clay loam in the upper 10 inches and light brownish-gray, slightly hard silt loam in the lower 9 inches. The underlying material is pale-brown silt loam.

Hord soils are slightly acid to neutral in the surface layer, neutral in the subsoil, and mildly alkaline to moderately alkaline and calcareous in the underlying material. Permeability is moderate, available water capacity is high, and natural fertility is high.

These soils are well suited to both dryland and irrigated crops. They are suited to all locally grown crops. Nearly all the acreage is cultivated. Some is in native grass.

Representative profile of Hord silt loam, 0 to 1 percent slopes, in a cultivated field, 0.15 mile north and 100 feet west of the southeast corner of sec. 14, T. 15 N., R. 11 W.:

Ap—0 to 6 inches, dark-gray (10YR 4/1) silt loam, very dark brown (10YR 2/2) when moist; weak, fine, granular structure parting to weak, very fine, granular; slightly hard when dry, friable when moist; slightly acid; abrupt, smooth boundary.

A12—6 to 20 inches, dark-gray (10YR 4/1) silt loam, very dark brown (10YR 2/2) when moist; weak, medium, subangular blocky structure parting to weak, fine, granular; slightly hard when dry, friable when moist; neutral; clear, smooth boundary.

B2—20 to 30 inches, grayish-brown (10YR 5/2) light silty clay loam, very dark grayish brown (10YR 3/2) when moist; weak, medium, subangular blocky structure parting to weak, fine, subangular blocky; hard when dry, firm when moist; neutral; clear, wavy boundary.

B3—30 to 39 inches, light brownish-gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) when moist; weak, medium, subangular blocky structure parting to weak, fine, subangular blocky; slightly hard when dry, friable when moist; neutral; clear, wavy boundary.

C—39 to 60 inches, pale-brown (10YR 6/3) silt loam, grayish brown (2.5Y 5/2) when moist; weak, medium, prismatic structure; soft when dry, very friable when moist; neutral.

The A horizon ranges from 12 to 20 inches in thickness and from dark gray to grayish brown in color. The B horizon ranges from 18 to 34 inches in thickness and from silt loam to silty clay loam in texture. It is 25 to 32 percent clay. In some areas sand deposits and buried soils occur in the C horizon.

Hord soils are associated with Hall, Detroit, and Hobbs soils. They have a less clayey B horizon than Hall or Detroit soils. In contrast with Hobbs soils, they have a B horizon and are less stratified.

Hord silt loam, 0 to 1 percent slopes (Hd).—This soil occupies irregularly shaped tracts 3 acres to several hundred acres in size on stream terraces.

Included in mapping are small areas of Hall silt loam, 0 to 1 percent slopes; small areas of Hobbs silt loam, 0 to 1 percent slopes; and some areas where the surface layer has been altered by land leveling.

Runoff is slow. In most years the main limitation for dryland crops is insufficient rainfall. Maintaining good tilth and fertility are management concerns in both dryland and irrigated areas.

This soil is well suited to cultivated crops, both dryland and irrigated. Nearly all the acreage is cultivated, and much of it is irrigated. Corn, sorghum, and alfalfa are the main crops. This soil is also suited to trees, grass, and other less intensive uses. Capability unit IIc–1 dryland, I–11 irrigated; Silty Lowland range site; Silty to Clayey windbreak group.

Inavale Series

The Inavale series consists of deep, excessively drained, nearly level to gently sloping soils on bottom land of the Loup River Valleys and in the southeastern part of the county. These soils formed in loamy and sandy alluvium.

In a representative profile, the surface layer is dark-gray loamy fine sand about 8 inches thick. The transitional layer is grayish-brown, soft loamy fine sand about 5 inches thick. The underlying material is fine sand and sand. This material is light brownish gray in the upper 10 inches and white below. The lower part has common, fine, faint, dark reddish-brown mottles.

Inavale soils have a slightly acid surface layer and are neutral below. Permeability is rapid, available water capacity is low, and natural fertility is low.

Inavale soils are suited to range and cultivated crops. Most of the acreage is used for range and hay.

Representative profile of Inavale loamy fine sand in

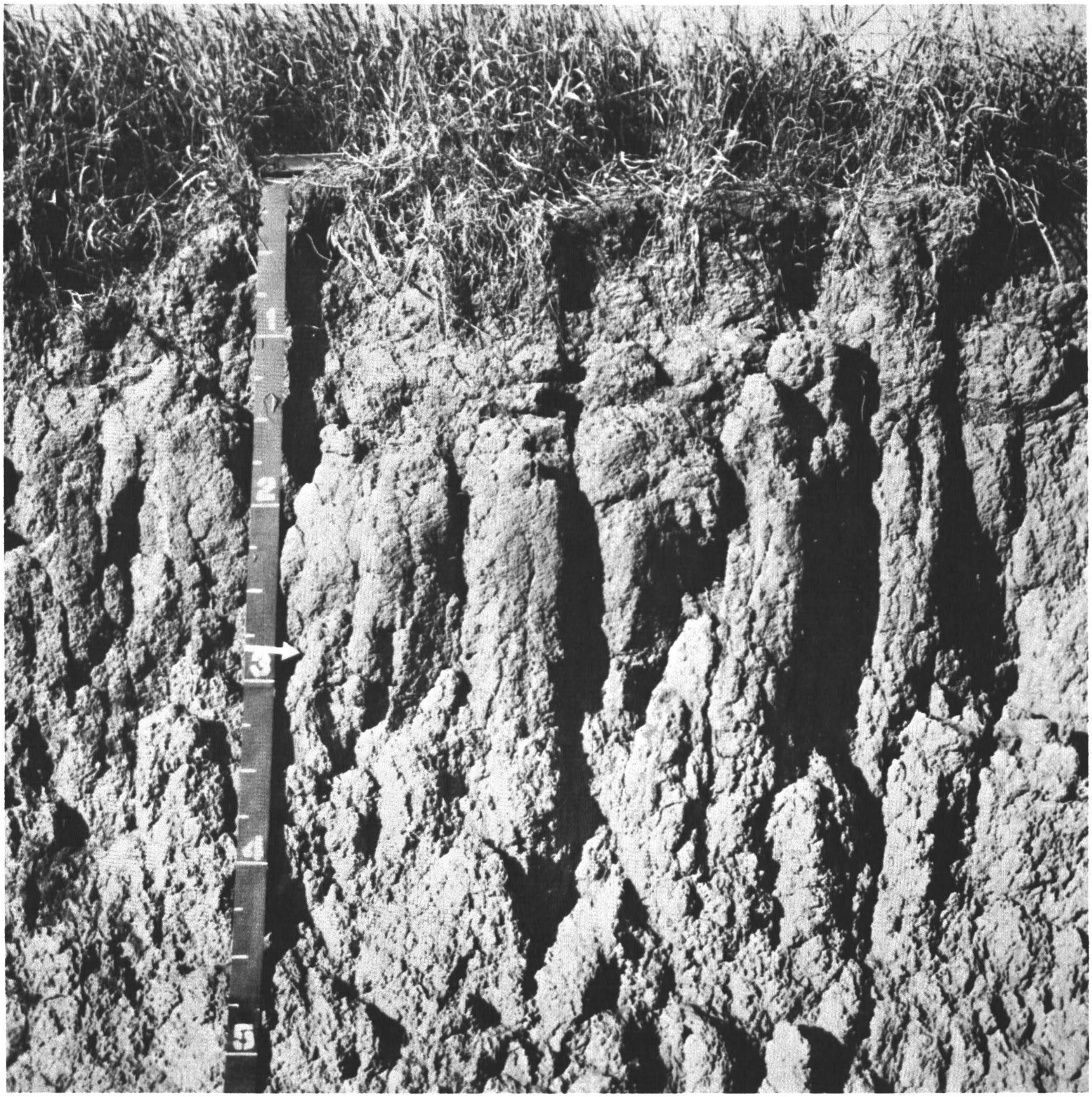

Figure 6.—**Profile of Hord silt loam, a deep soil that has a thick surface layer.**

native grass pasture, 150 feet north and 100 feet west of southeast corner of sec. 22, T. 13 N., R. 11W.:

A—0 to 8 inches, dark-gray (10YR 4/1) loamy fine sand, very dark brown (10YR 2/2) when moist; weak, fine, granular structure; soft when dry, very friable when moist; slightly acid; clear, smooth boundary.

AC—8 to 13 inches, grayish-brown (10YR 5/2) loamy fine sand, dark grayish brown (10YR 4/2) when moist; weak, medium, subangular blocky structure parting to weak, fine, subangular blocky; soft when dry, very friable when moist; neutral; clear, smooth boundary.

C1—13 to 23 inches, light brownish-gray (10YR 6/2) fine sand and sand, grayish brown (10YR 5/2) when moist; single grain; loose; neutral; clear, wavy boundary.

C2—23 to 60 inches, white (10YR 7/2) fine sand and sand,

light brownish gray (10YR 6/2) when moist; common, fine, faint, dark reddish-brown mottles; single grain; loose; neutral.

The A horizon ranges from loam to loamy sand in texture and from 5 to 10 inches in thickness. The AC horizon is as much as 10 inches thick. It ranges from fine sandy loam to sand in texture. The C horizon is thinly stratified with silt in some areas.

Inavale soils are associated with Boel and Darr soils. They have a deeper water table than Boel soils and are coarser textured than Darr soils.

Inavale fine sand (0 to 5 percent slopes) (If).—This soil occupies elongated tracts 3 acres to several hundred acres in size on bottom land and low stream terraces. It has a profile similar to the one described as representative for the series, but it has a fine sand surface layer.

Included in mapping are small areas of Inavale loamy fine sand.

Runoff is slow. Soil blowing is a hazard on unprotected fields. Low available water capacity, rapid permeability, and a low level of fertility are limitations.

Most of the acreage is in native grass and is used for range and hay. The soil is poorly suited to cultivated crops because it is too droughty and unstable. It is suited to trees and other less intensive uses. Capability unit VIe-5 dryland; Sands range site; Very Sandy windbreak group.

Inavale loamy fine sand (0 to 5 percent slopes) (Ig).—This soil occupies elongated tracts 3 acres to several hundred acres in size on bottom land and low stream terraces. It has the profile described as representative for the series.

Included in mapping are small areas of Inavale fine sandy loam and Inavale fine sand.

Runoff is slow. Soil blowing is a hazard on unprotected fields. Low available water capacity and low fertility are limitations.

Most of the acreage is in native grass and is used for range and hay. A small acreage is used for cultivated crops. Corn, sorghum, and alfalfa are the main crops. This soil is also suited to trees and other less intensive uses. Capability unit IIIe-5 dryland, IIIe-5 irrigated; Sands range site; Sandy windbreak group.

Inavale fine sandy loam (0 to 5 percent slopes) (In).—This soil occupies elongated tracts 3 to 50 acres in size on bottom land and low stream terraces. It has a profile similar to the one described as representative for the series, but it has a fine sandy loam surface layer.

Included in mapping are small areas of Inavale loamy fine sand and Inavale loam.

Runoff is slow. Soil blowing is a hazard in unprotected fields. Low available water capacity and low fertility are limitations.

Most of the acreage is in native grass and is used for range and hay. A small acreage is cultivated. Corn, sorghum, and alfalfa are the main crops. This soil is also suited to trees and other less intensive uses. Capability unit IIIe-3 dryland, IIIe-3 irrigated; Sands range site; Sandy windbreak group.

Inavale loam (0 to 5 percent slopes) (Ia).—This soil occupies elongated tracts 3 to 50 acres in size on bottom land and low terraces. It has a profile similar to the one described as representative for the series, but it has a loam surface layer.

Included in mapping are small areas of Inavale fine sandy loam and Darr silt loam.

Runoff is slow. Available water capacity is low, permeability is rapid, and fertility is low.

Most of the acreage is used for cultivated crops. The rest is in native grass. The soil is also suited to trees and other less intensive uses. Capability unit IIs-51 dryland, IIIe-11 irrigated; Sands range site; Sandy windbreak group.

Kenesaw Series

The Kenesaw series consists of deep, well-drained, nearly level to sloping soils on stream terraces and uplands. These soils formed in silty alluvium or loess.

In a representative profile, the surface layer is dark grayish-brown silt loam about 8 inches thick. The transitional layer is light brownish-gray, slightly hard silt loam about 6 inches thick. The underlying material is light-gray silt loam in the upper 32 inches and white, fine sand below.

Kennesaw soils are mildly alkaline in the surface layer and are moderately alkaline in the transition layer and underlying material. Permeability is moderate, available water capacity is high, and natural fertility is medium.

Kenesaw soils are suited to cultivated crops and range. They are suited to all locally grown crops. Most of the acreage is cultivated.

Representative profile of Kenesaw silt loam, 0 to 1 percent slopes, in a cultivated field, 0.2 mile east and 0.2 mile north of the southwest corner of sec. 28, T. 13 N., R. 9 W.:

Ap—0 to 5 inches, dark grayish-brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) when moist; weak, fine, granular structure; slightly hard when dry, friable when moist; mildly alkaline; abrupt, smooth boundary.

A12—5 to 8 inches, dark grayish-brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) when moist; weak, medium, subangular blocky structure parting to weak, fine, granular; slightly hard when dry, friable when moist; mildly alkaline; clear, wavy boundary.

AC—8 to 14 inches, light brownish-gray (2.5Y 6/2) silt loam, dark grayish brown (2.5Y 4/2) when moist; weak, coarse, subangular blocky structure parting to weak, medium, subangular blocky; slightly hard when dry, friable when moist; calcareous, moderately alkaline; few, fine, faint, dark reddish-brown iron stains; clear, wavy boundary.

C1—14 to 46 inches, light-gray (2.5Y 7/2) silt loam, grayish brown (2.5Y 5/2) when moist; weak, coarse, subangular blocky structure parting to weak, medium, subangular blocky; soft when dry, very friable when moist; calcareous, moderately alkaline; few, fine, distinct, dark reddish-brown iron stains; abrupt, wavy boundary.

IIC2—46 to 60 inches, white (2.5Y 8/2) fine sand, light gray (2.5Y 7/2) when moist; single grain; loose; mildly alkaline.

The A horizon ranges from very fine sandy loam to silt loam in texture, from 7 to 10 inches in thickness, and from dark gray to dark grayish brown in color. The AC horizon ranges from light brownish gray to light gray in color, from 9 to 16 inches in thickness, and from very fine sandy loam to light silty clay loam in texture. The C1 horizon ranges from very fine sandy loam to silt loam in texture and from 20 inches to many feet in thickness. The depth to the IIC2 horizon ranges from 40 inches to about 10 feet.

Kenesaw soils are associated with Holder, Hord, and Ortello soils. They differ from Holder soils in not having a B

horizon. They have a thinner A horizon than Hord soils, and lime is closer to the surface. They have a siltier C horizon than Ortello soils.

Kenesaw silt loam, 0 to 1 percent slopes (Ks).—This soil is in irregularly shaped tracts 3 to 100 acres in size on stream terraces and uplands. It has the profile described as representative for the Kenesaw series.

Included in mapping are small areas of Kenesaw silt loam, 1 to 5 percent slopes, and Ortello loam, 0 to 1 percent slopes; eroded areas; small alkali spots; and areas where the surface layer has been altered by land leveling.

Runoff is slow. In most years the main limitation for dryland crops is insufficient rainfall. Maintaining good tilth and high fertility is the main concern in management in irrigated areas.

Nearly all the acreage is cultivated. The soil is well suited to cultivated crops, both dryland and irrigated. Corn, sorghum, and alfalfa are the main crops. This soil is also suited to grass and trees. Capability unit IIc–1 dryland, I–11 irrigated; Silty range site; Silty to Clayey windbreak group.

Kenesaw silt loam, 1 to 5 percent slopes (KsB).—This soil occupies irregularly shaped tracts 3 acres to 200 acres in size on stream terraces and uplands.

Included in mapping are small areas of Kenesaw silt loam, 0 to 1 percent slopes, and Ortello loam, 1 to 5 percent slopes; small alkali and sand spots; and areas where the surface layer has been altered by land leveling.

Runoff is slow in nearly level areas and medium on the gentle slopes. Water erosion is a hazard on unprotected fields. Maintenance of tilth and fertility is the main concern in management.

Nearly all the acreage is cultivated. This soil is suited to both dryland and irrigated crops. Corn, sorghum, and alfalfa are the main crops. The soil is also suited to grass and trees and other less intensive uses. Capability unit IIe–1 dryland, IIe–1 irrigated; Silty range site; Silty to Clayey windbreak group.

Kenesaw silt loam, 5 to 11 percent slopes (KsC).—This soil occupies irregularly shaped areas 3 acres to 50 acres in size on uplands and stream terraces.

Included with this soil in mapping are small areas of sand that are shown on the map by spot symbols.

Runoff is medium. Water erosion is a hazard on unprotected fields. Maintaining tilth and fertility is the main concern in management.

Nearly all the acreage is cultivated. This soil is suited to cultivated crops. Corn, sorghum, and alfalfa are the main crops. The soil is also suited to grass and trees and other less intensive uses. Capability unit IIIe–1 dryland, IVe–1 irrigated; Silty range site; Silty to Clayey windbreak group.

Kenesaw-Slickspots complex (0 to 2 percent slopes) (KSz).—This mapping unit is about 70 percent Kenesaw silt loam and 30 percent Slickspots. These soils occupy stream terraces.

The profile of the Kenesaw soil is similar to that described for the Kenesaw series. Slickspots are described under the heading "Slickspots." They occur as alkali areas throughout the complex, mainly in depressions in flat basins that are 20 to 100 feet in diameter. They are surrounded by Kenesaw soils. In pastures Slickspots appear as small depressions or buffalo wallows, and in cultivated fields they appear as light-colored, puddled areas. They are difficult to work.

Included in mapping are small areas of Ortello loam, 1 to 5 percent slopes, and sandspots, which are shown on the map by spot symbols.

The main concern in management is the high alkalinity of the Slickspots. Surface drainage is needed. Runoff is slow. Permeability is very slow in the Slickspot areas. Phosphorus is deficient in these areas. If the soils are dry, they are hard and cloddy. If wet, they are sticky. Tractors commonly get stuck in these areas.

This soil complex is used for range and cultivated crops. Much of the cultivated land is irrigated. Corn, sorghum, and alfalfa are the main crops. Growth of crops is more favorable on the Kenesaw soil than on Slickspots. This soil complex is also suited to trees. Capability unit IVs–1 dryland, IIIs–1 irrigated; Kenesaw soil in Silty range site and Silty to Clayey windbreak group. Slickspots in Saline Lowland range site and Moderately Saline or Alkali windbreak group.

Lamo Series

The Lamo series consists of deep, somewhat poorly drained, nearly level soils on bottom land and low stream terraces in the Loup River Valleys. These soils formed in loamy alluvium. The water table fluctuates between depths of 2 and 6 feet.

In a representative profile, the surface layer is about 26 inches thick. It is very dark gray silt loam in the upper 5 inches, dark-gray silt loam in the next 8 inches, and very dark gray silty clay loam in the lower 13 inches. The transitional layer is dark-gray, very hard silty clay loam about 9 inches thick. The underlying material is gray silty clay loam that contains a few distinct, olive mottles in the upper part.

Lamo soils are mildly alkaline at the surface and moderately alkaline and calcareous below a depth of 5 inches. Permeability is moderately slow, available water capacity is high, and natural fertility is high.

Lamo soils are suited to cultivated crops and range. Most of the acreage is cultivated. Most locally grown crops are suited. Spring-sown small grain is not well suited, because of the high water table early in spring. Some of the acreage is in native grass.

Representative profile of Lamo silt loam in a cultivated field 350 feet north and 0.1 mile west of the southeast corner of sec. 18, T. 15 N., R. 10 W.:

Ap—0 to 5 inches, very dark gray (10 YR 3/1) silt loam, black (10YR 2/1) when moist; weak, coarse, granular structure parting to weak, fine, granular; slightly hard when dry, friable when moist; mildly alkaline; abrupt, smooth boundary.

A12—5 to 13 inches, dark gray (10YR 4/1) silt loam, black (10YR 2/1) when moist; weak, medium, subangular blocky structure parting to weak, very fine, subangular blocky; hard when dry, friable when moist; calcareous, moderately alkaline; abrupt, smooth boundary.

A13—13 to 26 inches, very dark gray (10YR 3/1) silty clay loam, black (10YR 2/1) when moist; moderate, medium, subangular blocky structure parting to moderate, fine, subangular blocky; very hard when dry, firm when moist; calcareous, moderately alkaline; clear, smooth boundary.

ACg—26 to 35 inches, dark-gray (2.5Y 4/1) silty clay loam, very dark gray (2.5Y 3/1) when moist; moderate, medium, subangular blocky structure parting to moderate, fine, subangular blocky; very hard when dry, firm when moist; calcareous, moderately alkaline; gradual, wavy boundary.

C1g—35 to 51 inches, gray (2.5Y 5/1) silty clay loam, dark gray (2.5Y 4/1) when moist; few, medium, distinct, olive mottles; moderate, medium, subangular blocky structure parting to moderate, fine, subangular blocky; hard when dry, firm when moist; calcareous, moderately alkaline; gradual, wavy boundary.

C2g—51 to 60 inches, gray (2.5Y 5/1) silty clay loam, dark gray (2.5Y 4/1) when moist; massive; hard when dry, firm when moist; calcareous, moderately alkaline.

The A horizon ranges from 16 to 30 inches in thickness, and the AC horizon from 8 to 20 inches. The C horizon ranges from silty clay loam to silt loam. In many areas the C horizon is mixed sand and gravel at a depth of 4 to 10 feet.

Lamo soils are associated with Gibbon and Ord Soils. They have a thicker A horizon than Gibbon or Ord soils, and they are more clayey in the AC and C horizons.

Lamo silt loam (0 to 2 percent slopes) (Lo).—This soil is on irregularly shaped, 3- to 60-acre tracts on bottom land and low stream terraces.

Included in mapping are small areas of Gibbon silt loam and Ord loam.

The main limitation is the moderately high water table that delays seedbed preparation early in spring. Runoff is slow. Surface drainage is needed during periods of heavy rainfall. Keeping this soil in good tilth and at a high level of fertility is a concern in management.

Nearly all the acreage of this soil is used for cultivated crops. Much of it is irrigated. Corn, sorghum, and alfalfa are the main crops. Spring-sown small grain is not well suited because the soil is wet. This soil is also suited to grass and trees. Capability unit IIw-4 dryland, IIw-4 irrigated; Subirrigated range site; Moderately Wet windbreak group.

Libory Series

The Libory series consists of deep, moderately well drained, nearly level to gently sloping soils on stream terraces south and east of the Middle Loup River. These soils formed in silty alluvium, loess, reworked eolian sand, or a combination of these.

In a representative profile, the surface layer is very dark grayish-brown loamy fine sand about 10 inches thick. The transitional layer is brown, soft loamy sand about 5 inches thick. The subsoil is dark grayish-brown silt loam about 14 inches thick. The upper part of the underlying material is light-gray silt loam, 6 inches thick, that has few reddish-brown mottles. The lower part is light-gray silty clay loam that has common reddish-brown mottles.

Libory soils are neutral throughout the profile. Permeability is moderate to moderately slow, available water capacity is high, and natural fertility is medium.

These soils are suited to cultivated crops and range. They are suited to most locally grown crops. Most of the acreage is cultivated. Some is in native grass.

The Libory soils in Howard County are mapped only with Boelus soils.

Representative profile of Libory loamy fine sand in a cultivated field in an area of Libory-Boelus loamy fine sands, 350 feet west and 75 feet north of the southeast corner of sec. 35, T. 15 N., R. 9 W.:

Ap—0 to 10 inches, very dark grayish-brown (10YR 3/2) loamy fine sand, very dark brown (10YR 2/2) when moist; weak, fine, granular structure; soft when dry, very friable when moist; neutral; abrupt, smooth boundary.

A12—10 to 15 inches, brown (10YR 5/3) loamy sand, dark brown (10YR 4/3) when moist; weak, medium, subangular blocky structure parting to weak, very fine, granular; soft when dry, very friable when moist; neutral; clear, wavy boundary.

IIB2b—15 to 29 inches, dark grayish-brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) when moist; weak, coarse, subangular blocky structure parting to weak, medium, subangular blocky; slightly hard when dry, friable when moist; neutral; clear, wavy boundary.

IIC1—29 to 35 inches, light-gray (2.5Y 7/2) silt loam, grayish brown (2.5Y 5/2) when moist; few, fine, faint, reddish-brown mottles; weak, coarse, subangular blocky structure parting to weak, medium, subangular blocky; slightly hard when dry, friable when moist; neutral; gradual, wavy boundary.

IIC2—35 to 60 inches, light-gray (2.5Y 7/2) silty clay loam, light brownish gray (2.5Y 6/2) when moist; common, medium, distinct, reddish-brown mottles; massive; very hard when dry, firm when moist; neutral.

The Ap horizon ranges from loamy fine sand to fine sand in texture, from 7 to 14 inches in thickness, and from dark grayish brown to very dark grayish brown in color. The A12 horizon ranges from loamy fine sand to fine sand in texture and from 5 to 16 inches in thickness. The IIB and IIC horizons range from 1 to 25 feet in thickness. but in most areas the substratum is sandy material at a depth of 4 to 10 feet. The IIAB horizon is absent in many areas.

Libory soils are associated with Boelus, Loretto, and Ovina soils. They have a more mottled and grayish colored C horizon than Boelus soils and a coarser textured A12 horizon than Loretto soils. They have a lower water table and a finer textured C horizon than Ovina soils.

Libory-Boelus fine sands (0 to 5 percent slopes) (LB).—This mapping unit is about 65 percent Libory fine sand and 25 percent Boelus fine sand. Kenesaw silt loam, 1 to 5 percent slopes, and Valentine fine sand, rolling, make up the remaining 10 percent. These soils are on stream terraces.

The principal soils in this complex have characteristics similar to those described as representative for their respective series, but they have a fine sand surface layer. In cultivated areas, soil blowing has winnowed the surface layer and changed the original thickness and color. The surface layer is thicker in the swales and thinner on the knobs. Much of the organic matter has been removed.

Runoff is slow. Soil blowing is a serious hazard on unprotected fields. Maintaining good tilth and a high level of fertility is another concern in management.

This complex is used for range and cultivated crops. Most of the acreage is in native grass. The rest is cultivated. Corn, sorghum, and alfalfa are the main crops. The soils are also suited to trees and other less intensive uses. Capability unit IVe-5 dryland; Sands range site; Very Sandy windbreak group.

Libory-Boelus loamy fine sands (0 to 5 percent slopes) (LC).—This mapping unit is made up of areas of Libory loamy fine sand and Boelus loamy fine sand that are so intermingled it is not practicable to separate them on the soil map. Libory loamy fine sand makes up 70 percent of

the unit, Boelus loamy fine sand makes up 25 percent, and Thurman loamy fine sand, 0 to 3 percent slopes, and Kenesaw silt loam, 1 to 5 percent slopes, make up the remaining 5 percent. These soils are on stream terraces.

The soils in this complex have the profiles described as representative for their respective series.

Runoff is slow. Soil blowing is a serious hazard on unprotected fields. Maintaining good tilth and a high level of fertility is another concern in management.

Most of the acreage is used for cultivated crops. Corn, sorghum, and alfalfa are the main crops. Some of the acreage is in native grass and is used for range. This complex is also suited to trees and to other less intensive uses. Capability unit IIIe–5 dryland, IIIe–5 irrigated; Sandy range site; Sandy windbreak group.

Loretto Series

The Loretto series consists of deep, well-drained, nearly level to gently sloping soils on stream terraces south and east of the Middle Loup River. These soils formed in loess and eolian sand.

In a representative profile, the surface layer is dark grayish-brown loamy fine sand and fine sandy loam about 18 inches thick. It is loamy fine sand in the upper 7 inches and fine sandy loam in the lower 11 inches. The subsoil is hard silt loam about 20 inches thick. It is brown in the upper 14 inches and pale brown in the lower 6 inches. The underlying material is pale-brown silt loam.

Loretto soils are slightly acid in the surface layer, mildly alkaline in the subsoil, and moderately alkaline and calcareous in the underlying material. Permeability is moderate, available water capacity is high, and natural fertility is medium.

Loretto soils are well suited to cultivated crops and range. Most of the acreage is cultivated. Some is in native grass. Most locally grown crops are suited.

Representative profile of Loretto loamy fine sand in an area of Loretto complex, 0 to 5 percent slopes, in a cultivated field, 0.25 mile east and 0.25 mile north of the southwest corner of sec. 34, T. 13 N., R. 9 W.:

Ap—0 to 7 inches, dark grayish-brown (10YR 4/2) loamy fine sand, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure; soft when dry, very friable when moist; slightly acid; abrupt, smooth boundary.

A12—7 to 18 inches, dark grayish-brown (10YR 4/2) fine sandy loam, very dark brown (10YR 2/2) when moist; weak, coarse, subangular blocky structure parting to weak, medium, subangular blocky; soft when dry, very friable when moist; neutral; clear, wavy boundary.

B2—18 to 32 inches, brown (10YR 5/3) silt loam, dark grayish brown (10YR 4/2) when moist; weak, medium, prismatic structure parting to weak, medium, subangular blocky; hard when dry, firm when moist; mildly alkaline; clear, wavy boundary.

B3—32 to 38 inches, pale-brown (10YR 6/3) silt loam, brown (10YR 5/3) when moist; weak, medium, prismatic structure parting to weak, medium, subangular blocky; hard when dry, firm when moist; mildly alkaline; clear, wavy boundary.

C—38 to 60 inches, pale-brown (10YR 6/3) silt loam, brown (10YR 5/3) when moist; massive; slightly hard when dry, friable when moist; moderately alkaline.

The Ap horizon ranges from fine sandy loam to loamy fine sand. The combined thickness of the Ap and A1 horizons is 12 to 20 inches. The B horizon ranges from 12 to 30 inches in thickness and from loam to silty clay loam in texture. Buried surface layers ranging from very dark grayish brown to grayish brown are common in the C horizon.

Loretto soils are associated with Boelus, Libory, and Ortello soils. They have a finer textured A12 horizon than Boelus and Libory soils and a finer textured C horizon than Ortello soils.

Loretto complex, 0 to 5 percent slopes (L).—This mapping unit is about 50 percent Loretto soils, and about 45 percent soils that are similar to Loretto soils, but have mottled and grayish silt loam underlying material, like the underlying material described for Libory soils. Ortello loam, 0 to 1 percent slopes, and Kenesaw silt loam, 0 to 1 percent slopes, make up the remaining 5 percent. The soils in this complex are so intermingled it is not practicable to separate them on the soil map. They are on stream terraces. Areas are 3 to 100 acres in size.

The Loretto, Kenesaw, and Ortello soils have characteristics similar to those described as representative for their respective series. The surface layer generally is fine sandy loam, but the plow layer ranges from fine sandy loam to loamy sand in cultivated fields.

Runoff is medium. Soil blowing is a hazard on unprotected fields. Good tilth and a high level of fertility must be maintained.

Most of the acreage of this complex is used for cultivated crops. Corn, sorghum, and alfalfa are the main crops. Some of the acreage is in native grass used for range. These soils are also suited to trees and to other less intensive uses. Capability unit IIe–3 dryland, IIe–3 irrigated; Sandy range site; Sandy windbreak group.

Marsh

Marsh (M) is very poorly drained and frequently flooded. It is made up of nearly level, old river channels. The water table is at or above the surface most of the year.

In most places the soil material is a thin layer of silt loam over sand. Thin to thick layers of organic material cover much of the area.

Marsh supports a thick stand of cattails, rushes, sedges, and other aquatic plants. It is suitable only as wildlife habitat and recreation areas. Capability unit VIIIw–1; Undesirable windbreak group.

Nuckolls Series

The Nuckolls series consists of steep, deep, excessively drained soils that are on uplands adjacent to the Loup River Valleys. These soils formed in somewhat reddish loess, older than Peoria Loess.

In a representative profile, the surface layer is dark grayish-brown silt loam about 7 inches thick. The subsoil is about 37 inches thick. It has 4 distinct layers. The top 7 inches is grayish-brown, hard silty clay loam. The next layer is a brown, hard silty clay loam 10 inches thick that overlies a grayish-brown, hard light silty clay loam 15 inches thick. The lower 5 inches of the subsoil is light-brown silt loam. The underlying material is reddish-yellow silt loam.

Nuckolls soils are neutral in the surface layer and upper part of the subsoil and calcareous and moderately alkaline in the lower part of the subsoil and underlying

material. Permeability is moderately slow, available water capacity is high, and natural fertility is medium.

Nearly all the acreage is pasture. The soils are not suitable for cultivation because of the steep slopes and severe hazard of water erosion.

Representative profile of Nuckolls silt loam in an area of Nuckolls soils, 15 to 31 percent slopes, severely eroded, 0.4 miles south and 0.18 mile west of the northeast corner of sec. 3, T. 15 N., R. 9 W.:

A—0 to 7 inches, dark grayish-brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) when moist; weak, medium, subangular blocky structure parting to weak, fine, granular; slightly hard when dry, friable when moist; neutral; clear, smooth boundary.

B1—7 to 14 inches, grayish-brown (10YR 5/2) silty clay loam, dark grayish brown (10YR 4/2) when moist; weak, medium, prismatic structure parting to weak, medium, subangular blocky; hard when dry, firm when moist; neutral; clear, wavy boundary.

B21—14 to 24 inches, brown (10YR 5/3) silty clay loam, dark brown (10YR 4/3) when moist; moderate, medium, prismatic structure parting to moderate, medium, subangular blocky; hard when dry, firm when moist; neutral; clear, wavy boundary.

B22—24 to 39 inches, grayish-brown (10YR 5/2) light silty clay loam, dark grayish brown (10YR 4/2) when moist; moderate, medium, prismatic structure parting to moderate, medium, subangular blocky; hard when dry, firm when moist; neutral; clear, wavy boundary.

B3—39 to 44 inches, light-brown (7.5YR 6/4) silt loam, brown (7.5YR 5/4) when moist; weak, medium, prismatic structure parting to weak, medium, subangular blocky; slightly hard when dry, firm when moist; calcareous, moderately alkaline; clear, wavy boundary.

C—44 to 60 inches, reddish-yellow (7.5YR 7/6) silt loam, reddish yellow (7.5YR 6/6) when moist; weak, coarse, prismatic structure or massive; slightly hard when dry, firm when moist; calcareous, moderately alkaline.

The A horizon ranges from silt loam to light silty clay loam in texture and from 7 to 10 inches in thickness. It is very dark grayish brown to dark grayish brown. The B horizon ranges from 14 to 40 inches in thickness. It is 25 to 32 percent clay. The C horizon is at a depth of 21 to 50 inches.

In many areas the A horizon is thinner and lighter colored than is defined in the range for the series. Erosion has removed all or nearly all the original A horizon. This difference, however, does not alter the usefulness or behavior of the soils.

Nuckolls soils are associated with Holder, Uly, Coly, and Geary soils. They formed in material that is somewhat redder then the material in which Holder, Uly, and Coly soils formed. They differ from Coly soils in having a B horizon. They have a less clayey B horizon than Geary soils.

Nuckolls soils, 15 to 31 percent slopes, severely eroded (NsD3).—This unit is along upland drainageways in tracts 50 to several hundred acres in size. The surface layer is mainly loam but ranges from silt loam to silty clay loam. It has been eroded, and the subsoil is exposed in many areas.

Included in mapping are small areas of Coly silt loam, 15 to 31 percent slopes, and Hobbs silt loam, occasionally flooded.

Runoff is rapid, and the hazard of erosion is severe.

The unit is best suited to native grass. It is not well suited to cultivation because it is too steep and the hazard of water erosion is severe. All the acreage is in grass and is used for range or hay. The soils are also suited to trees and other less intensive uses. Capability unit VIe–8 dryland; Silty range site; Silty to Clayey windbreak group.

O'Neill Series

The O'Neill series consists of moderately deep, nearly level to very gently sloping, well-drained soils on stream terraces in the Loup River Valleys. These soils formed in alluvium.

In a representative profile, the surface layer is dark grayish-brown loam about 14 inches thick. The subsoil is about 12 inches thick. It is dark grayish-brown, soft fine sandy loam in the upper 6 inches and grayish-brown, soft loamy sand in the lower 6 inches. The underlying material is light brownish-gray, mixed fine sand, coarse sand, and fine gravel.

O'Neill soils are slightly acid in the upper part of the surface layer and neutral below. Permeability is moderately rapid, available water capacity is low, and natural fertility is medium.

Nearly all the acreage of O'Neill soils is in cultivated crops. The soils are suited to most locally grown crops. They are not well suited to deep-rooted crops unless they are irrigated.

Representative profile of O'Neill loam, 0 to 3 percent slopes, in a bromegrass pasture, 0.24 mile west and 0.46 mile south of the northeast corner of sec. 9, T. 14 N., R. 10 W.:

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) loam, very dark brown (10YR 2/2) when moist; weak, fine, granular structure; slightly hard when dry, friable when moist; slightly acid; clear, wavy boundary.

A12—8 to 14 inches, dark grayish-brown (10YR 4/2) loam, very dark brown (10YR 2/2) when moist; weak, coarse, subangular blocky structure parting to weak, fine, subangular blocky; slightly hard when dry, friable when moist; neutral; gradual, wavy boundary.

B22—14 to 20 inches, dark grayish-brown (10YR 4/2) fine sandy loam, very dark brown (10YR 2/2) when moist; weak, coarse, subangular blocky structure parting to weak, fine, subangular blocky; soft when dry, very friable when moist; neutral; clear, wavy boundary.

B23—20 to 26 inches, grayish-brown (10YR 5/2) loamy sand, dark grayish brown (10YR 4/2) when moist; weak, coarse, subangular blocky structure parting to single grain; soft when dry, very friable when moist; neutral; gradual, wavy boundary.

C—26 to 60 inches, light brownish-gray (10YR 6/2), mixed fine sand, coarse sand and fine gravel, grayish brown (10YR 5/2) when moist; single grain; loose; neutral.

The A horizon ranges from silt loam to sandy loam in texture and from 8 to 16 inches in thickness. It is dark grayish brown to very dark grayish brown. The B horizon ranges from 12 to 24 inches in thickness. Mixed sand and gravel is at a depth of 20 to 40 inches.

O'Neill soils are associated with Simeon and Ortello soils. They have coarse sand and gravel at a depth of 20 to 40 inches, Simeon soils have coarse sand above a depth of 20 inches, and Ortello soils have fine sand below a depth of 40 inches.

O'Neill loam, 0 to 3 percent slopes (Ok).—This soil is in irregularly shaped tracts 3 to 100 acres in size on stream terraces.

Included in mapping are small areas of Ortello loam, 0 to 1 percent slopes. Droughtiness is the main management concern. The root zone is moderately deep and available water capacity is low. Runoff is slow. Main-

taining good tilth and a high level of fertility is also a concern.

Most of the acreage is cultivated. Some of it is irrigated. Corn and sorghum are the main crops. This soil is also suited to grass and trees and other less intensive uses. It is not well suited to deep-rooted crops unless it is irrigated. Capability unit IIs-5 dryland, IIe-11 irrigated; Sandy range site; Silty to Clayey windbreak group.

Ord Series

The Ord series consists of deep, nearly level to very gently sloping, somewhat poorly drained soils on bottom land in the Loup River Valleys. These soils formed in alluvium. The water table fluctuates between depths of 2 and 6 feet.

In a representative profile, the surface layer is loam about 14 inches thick. It is dark gray in the upper 8 inches and very dark gray in the lower 6 inches. The transitional layer is gray, soft sandy loam about 12 inches thick. The underlying material is white fine sand. It has a few distinct, reddish-brown mottles.

Ord soils are moderately alkaline and calcareous in the surface layer and transitional layer. They are mildly alkaline in the underlying material. Permeability is moderately rapid, available water capacity is moderate to low, and natural fertility is medium.

Ord soils are suited to most locally grown, cultivated crops and to range. Most areas are in range. The soil is not well suited to spring-sown small grain because the water table is high early in spring.

Representative profile of Ord loam in an area of native grass, 100 feet west and 0.3 mile south of northeast corner of sec. 13, T. 15 N., R. 11 W.:

A11—0 to 8 inches, dark-gray (10YR 4/1) loam, very dark brown (10YR 2/2) when moist; weak, medium, subangular blocky structure parting to weak, fine, granular; slightly hard when dry, friable when moist; calcareous, moderately alkaline; clear, smooth boundary.

A12—8 to 14 inches, very dark gray (10YR 3/1) loam, black (10YR 2/1) when moist; weak, medium, subangular blocky structure parting to weak, fine, granular; slightly hard when dry, friable when moist; calcareous, moderately alkaline; clear, smooth boundary.

AC—14 to 26 inches, gray (10YR 5/1) sandy loam, dark gray (10YR 4/1) when moist; weak, medium, subangular blocky structure parting to weak, fine, subangular blocky; soft when dry, very friable when moist; calcareous, moderately alkaline; abrupt, smooth boundary.

IIC—26 to 60 inches, white (10YR 8/2) fine sand, light brownish gray (10YR 6/2) when moist; few, distinct, reddish-brown mottles; single grain; loose; mildly alkaline.

The A horizon ranges from loam to sandy loam in texture and from 9 to 16 inches in thickness. The AC horizon ranges from 11 to 14 inches in thickness. The IIC horizon is at a depth of 20 to 30 inches. Stratified silty material is common in many areas.

Ord soils are associated with Boel and Darr soils. They have fine sand between depths of 20 to 40 inches, and Boel soils have fine sand above a depth of 20 inches. Ord soils have a higher water table than Darr soils and finer textured sand in the C horizon.

Ord fine sandy loam (0 to 2 percent slopes) (Of).—This soil is on bottom land in the Loup River Valleys, in irregularly shaped tracts 3 to 50 acres in size. It has a profile similar to the one described as representative for the series, but it has a fine sandy loam surface layer.

Included in mapping are small areas of Boel fine sandy loam and Ord loam and small areas of Inavale fine sand that are shown on the map by a sand spot symbol.

Runoff is slow. Soil blowing is a hazard on unprotected fields. The main limitation is the moderately high water table that delays seedbed preparation early in spring. Proper levels of fertility must be maintained. Surface drainage is generally beneficial.

Most of the acreage is used for range or hay. In some areas next to the rivers, trees are the dominant vegetation. Areas not used for range or woodland are cultivated. Corn, sorghum, and alfalfa are the main crops. This soil is not well suited to spring-sown small grain because the water table is moderately high early in spring. Capability unit IIw-6 dryland, IIw-6 irrigated; Subirrigated range site; Moderately Wet windbreak group.

Ord loam (0 to 2 percent slopes) (Oe).—This soil is in irregularly shaped tracts 3 to 50 acres in size on bottom land in the Loup River Valleys. It has the profile described as representative for the series. The surface layer is typically loam but ranges from loam to silt loam.

Included in mapping are small areas of Gibbon silt loam and Boel loam and small areas of Inavale fine sand that are shown on the map by a sand spot symbol.

Runoff is slow. The main limitation on this soil is the moderately high water table that delays seedbed preparation early in spring. Maintaining a proper level of fertility is a concern. Surface drainage is generally beneficial.

Most of the acreage is used for range or hay. In some areas next to the rivers, trees are the dominant vegetation. The rest of the acreage is cultivated. Some of it is irrigated. Corn, sorghum, and alfalfa are the main crops. Spring-sown small grain is not well suited because the water table is moderately high early in spring. Capability unit IIw-4 dryland, IIw-4 irrigated; Subirrigated range site; Moderately Wet windbreak group.

Ortello Series

The Ortello series consists of deep, well-drained, nearly level to steep soils on stream terraces and uplands. These soils formed in eolian sand or wind reworked alluvium.

In a representative profile, the surface layer is about 15 inches thick. It is grayish-brown loamy fine sand in the upper 7 inches and dark-gray fine sandy loam in the lower 8 inches. The transitional layer is grayish-brown, soft fine sandy loam about 10 inches thick. The underlying material has 3 distinct layers. The upper 17 inches is pale-brown loamy fine sand. The next layer is 8 inches of grayish-brown fine sandy loam. The lower layer is light-gray fine sand.

Ortello soils are slightly acid to neutral in the surface layer and are neutral in the transitional layer and underlying material. Permeability is moderately rapid, available water capacity is moderate, and natural fertility is medium.

Ortello soils are suited to cultivated crops and range. Most of the acreage is cultivated. Some is in range. All locally grown crops are suited.

Representative profile of Ortello loamy fine sand, 1 to 5 percent slopes, in a cultivated field, 0.2 mile east and 0.15 mile south of the northwest corner of sec. 32, T. 15 N., R. 10 W.:

Ap—0 to 7 inches, grayish-brown (10YR 5/2) loamy fine sand, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure; soft when dry, very friable when moist; slightly acid; clear, smooth boundary.

A12—7 to 15 inches, dark-gray (10YR 4/1) fine sandy loam, very dark brown (10YR 2/2) when moist; weak, fine, subangular blocky structure parting to weak, fine, granular; soft when dry, very friable when moist; neutral; clear, wavy boundary.

AC—15 to 25 inches, grayish-brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) when moist; weak, medium, subangular blocky structure parting to weak, fine, subangular blocky; soft when dry, very friable when moist; neutral; clear, wavy boundary.

C—25 to 42 inches, pale-brown (10YR 6/3) loamy fine sand, brown (10YR 5/3) when moist; weak, medium, subangular blocky structure parting to weak, fine, subangular blocky; soft when dry, very friable when moist; neutral; clear, wavy boundary.

Ab—42 to 50 inches, grayish-brown (2.5Y 5/2) fine sandy loam, dark grayish brown (2.5Y 4/2) when moist; weak, medium, subangular blocky structure parting to weak, fine, subangular blocky; soft when dry, very friable when moist; neutral; clear, smooth boundary.

IIC—50 to 60 inches, light-gray (2.5Y 7/2) fine sand, light brownish gray (2.5Y 6/2) when moist; single grain; loose; neutral.

The A horizon ranges from loam to loamy fine sand in texture and from 8 to 18 inches in thickness. The AC horizon ranges from 8 to 14 inches in thickness and from grayish brown to pale brown in color.

Ortello soils are assocated with Thurman, Kenesaw, and O'Neill soils. They have a finer textured AC horizon than Thurman soils, and they are coarser textured throughout the profile than Kenesaw soils. They are deeper over fine and coarse sand than O'Neill soils.

Ortello loamy fine sand, 1 to 5 percent slopes (ObB).—This soil is in irregularly shaped tracts 3 to 100 acres in size on uplands and stream terraces. It has the profile described as representative for the series.

Included in mapping are small areas of Kenesaw silt loam, 1 to 5 percent slopes; Thurman loamy fine sand, 0 to 3 percent slopes; and areas where part of the surface layer has been removed through soil blowing.

Runoff is slow. Soil blowing is a hazard on unprotected fields. The moderate available water capacity and the need for maintaining good tilth and a high level of fertility are the main concern of management.

This soil is suited to cultivated crops. Most of the acreage is cultivated; some is irrigated. Corn, sorghum, and alfalfa are the main crops. This soil is also suited to grass and trees, and it provides suitable habitat for wildlife. Capability unit IIIe-5 dryland, IIIe-5 irrigated; Sandy range site; Sandy windbreak group.

Ortello fine sandy loam, 0 to 1 percent slopes (OrA).—This soil occupies irregularly shaped tracts 3 to 50 acres in size on uplands and stream terraces. It has a profile similar to the one described as representative for the series, but the upper part of the surface layer is fine sandy loam.

Included in mapping are small areas of Ortello loam, 0 to 1 percent slopes, and Thurman loamy fine sand, 0 to 3 percent slopes.

Runoff is slow. Soil blowing is a hazard on unprotected fields. Maintaining good tilth and a high level of fertility is the main concern of management. Available water capacity is moderate.

This soil is well suited to cultivated crops. Nearly all the acreage is cultivated. Corn, sorghum, and alfalfa are the main crops. The soil is also suited to grass and trees and to other less intensive uses. Capability unit IIe-3 dryland, IIe-3 irrigated; Sandy range site; Sandy windbreak group.

Ortello loam, 0 to 1 percent slopes (Ot).—This soil is in irregularly shaped tracts 3 to 200 acres in size on uplands and stream terraces. It has a profile similar to the one described as representative for the series. Its surface layer is generally loam, but ranges to silt loam.

Included in mapping are small areas of Kenesaw silt loam, 0 to 1 percent slopes.

Runoff is slow. The main limitation for dryland crops is insufficient rainfall. Maintaining fertility and good tilth is the main concern in both dryland and irrigated areas.

This soil is suited to cultivated crops. Nearly all the acreage is cultivated; some is irrigated. Corn, sorghum, and alfalfa are the main crops. This soil is also suited to grass and trees and to other less intensive uses. Capability unit IIc-1 dryland, I-11 irrigated; Sandy range site; Sandy windbreak group.

Ortello loam, 1 to 5 percent slopes (OtB).—This soil is in irregularly shaped tracts 3 to 50 acres in size on uplands and stream terraces. It has a profile similar to the one described as representative for the series. Its surface layer is typically loam, but ranges to silt loam.

Included in mapping are small areas of Kenesaw silt loam, 1 to 5 percent slopes, and Ortello loamy fine sand, 1 to 5 percent slopes.

Runoff is slow. Water erosion is a slight hazard on unprotected fields. Maintaining good tilth and a high level of fertility is the main concern of management.

Most of the acreage is cultivated. Corn, sorghum, and alfalfa are the main crops. The soil is also suited to grass and trees and to other less intensive uses. Capability unit IIe-1 dryland, IIe-1 irrigated; Sandy range site; Sandy windbreak group.

Ortello-Coly complex, 15 to 31 percent slopes (OxD).—This mapping unit is about 50 percent Ortello soils, 30 percent Coly soils, and 20 percent Kenesaw, Valentine, and Thurman soils. These soils are on breaks and areas adjacent to upland drainageways. They are so intermingled that it is not practicable to map them separately.

These soils are subject to severe erosion if the grass cover is removed. Runoff is rapid, and fertility is low.

The soils are too steep and too subject to severe erosion for cultivation. They are well suited to native grass. Nearly all the acreage is in native grass and is used for grazing and hay. Soils in this unit are also suited to trees and to use as habitat for upland wildlife. Capability unit VIe-3 dryland; Ortello soil in the Sandy range site and Sandy windbreak group; Coly soil in Limy Upland range site and Silty to Clayey windbreak group.

Ovina Series

The Ovina series consists of deep, somewhat poorly drained, nearly level to very gently sloping soils on stream terraces and bottom lands south and east of the Middle Loup River. These soils formed in alluvium, loess, eolian sand, or a combination of these. The water table fluctuates between depths of 2 and 6 feet.

In a representative profile, the surface layer is very dark gray loamy fine sand about 8 inches thick. The underlying material has 4 distinct layers. The upper 15 inches is light brownish-gray fine sandy loam that contains a few distinct, reddish-brown mottles. The next layer is gray fine sandy loam about 4 inches thick that also contains a few distinct, reddish-brown mottles. The next layer is light brownish-gray loam about 10 inches thick. It has a few distinct, dark reddish-brown mottles. The lower layer is light-gray fine sandy loam that contains a few distinct, dark reddish-brown mottles.

Ovina soils are mildly alkaline to moderately alkaline throughout the profile. They are calcareous in the surface layer and in the upper part of the underlying material. Permeability is moderately rapid, available water capacity is moderate, and natural fertility is medium.

Most of the acreage is in native grass. Some is used for cultivated crops. Most locally grown crops are suited. Small grain is not well suited because the water table is high in spring.

Representative profile of Ovina loamy fine sand in a native grass hay meadow, 0.2 mile south and 0.15 mile east of the northwest corner of sec. 9, T. 13 N., R. 10 W.:

A—0 to 8 inches, very dark gray (10YR 3/1) loamy fine sand, black (10YR 2/1) when moist; weak, fine, granular structure; soft when dry, very friable when moist; calcareous, mildly alkaline; abrupt, smooth boundary.

AC—8 to 11 inches, dark grayish-brown (10YR 4/2) loamy fine sand, very dark grayish brown (10YR 3/2) when moist; weak, medium, subangular blocky structure parting to weak, fine, granular; soft when dry, very friable when moist; calcareous, moderately alkaline; clear, wavy boundary.

C1—11 to 26 inches, light brownish-gray (10YR 6/2) fine sandy loam, grayish brown (10YR 5/2) when moist: few, fine, distinct, reddish-brown mottles; weak, coarse, subangular blocky structure parting to weak. fine, subangular blocky; soft when dry, very friable when moist; calcareous, moderately alkaline; clear, wavy boundary.

C2—26 to 30 inches, gray (10YR 5/1) fine sandy loam, dark gray (10YR 4/1) when moist; few, fine, distinct, reddish-brown mottles; weak, coarse, subangular blocky structure parting to weak, medium, subangular blocky; slightly hard when dry, friable when moist; calcareous, moderately alkaline; clear, wavy boundary.

IIC3—30 to 40 inches, light brownish-gray (2.5Y 6/2) loam, grayish brown (2.5Y 5/2) when moist; few, fine, distinct, dark reddish-brown mottles; massive; slightly hard when dry, friable when moist; mildly alkaline; gradual, wavy boundary.

IIC4—40 to 60 inches, light-gray (2.5Y 7/2) fine sandy loam, light brownish gray (2.5Y 6/2) when moist; few, fine, distinct, dark reddish-brown mottles; massive; soft when dry, very friable when moist; mildly alkaline.

The A horizon ranges from fine sandy loam to loamy sand in texture and from 7 to 10 inches in thickness. The AC horizon ranges from 2 to 10 inches in thickness. The C horizon ranges from 6 to 20 inches in thickness. The IIC horizon is stratified with material that ranges from loamy fine sand to silty clay loam. It is finer textured than the C horizon and restricts the downward movement of water.

Ovina soils are associated with Libory, Elsmere, and Tryon soils. They are more poorly drained than Libory soils and have a coarser textured C horizon. They have a finer textured C horizon than Elsmere soils. They are better drained than Tryon soils and are not so coarse textured in the C horizon.

Ovina loamy fine sand (0 to 3 percent slopes) (Oa).—This soil is in irregularly shaped, 3- to 60-acre tracts on bottom land and stream terraces.

Included in mapping are small areas of Valentine and Thurman soils, 0 to 17 percent slopes and Elsmere loamy fine sand.

Runoff is slow, and fertility is medium. Soil blowing and land leveling for irrigation have altered the thickness of the surface layer in some places, and soil blowing is a hazard on unprotected fields. The main limitation is the moderately high water table that delays seedbed preparation early in spring.

Most of the acreage is in native grass used for range and hay. Some of it is used for irrigated crops. Corn, sorghum, and alfalfa are the main crops. Spring-sown small grain is not well suited due to wetness early in spring. This soil is also suited to trees and to other less intensive uses. Capability unit IIIw–5 dryland, IIIw–5 irrigated; Subirrigated range site; Moderately Wet windbreak group.

Rough Broken Land, Loess

Rough broken land, loess (31 to 65 percent slopes) (RB) is on terrace breaks. The very steep slopes are adjacent to deep upland drainageways and gullies. Catsteps are common on the steepest slopes.

Rough broken land, loess, varies widely in texture and soil development. The soil material is mainly loess, but sand and mixtures of sand and loess are common. About 60 percent of the acreage is a very thin soil that formed in loess. Lime is at or near the surface in much of the area.

Runoff is rapid, permeability is moderate, and available water capacity is moderate to high.

Rough broken land, loess, is suited only to grass and trees. Nearly all the acreage is in native grass and trees, and it is used for range. Capability unit VIIe–1 dryland; Thin Loess range site; Silty to Clayey windbreak group.

Rusco Series

The Rusco series consists of deep, moderatelly well drained, nearly level soils on stream terraces. These soils formed in alluvial material, loess, or both.

In a representative profile, the surface layer is very dark grayish-brown silt loam about 7 inches thick. The subsoil is slightly hard silty clay loam about 19 inches thick. It is grayish-brown in the upper 6 inches and brown in the lower part. The underlying material is light-gray silt loam that contains common, medium, distinct, reddish-brown mottles.

Rusco soils are neutral in the surface layer, mildly alkaline in the subsoil, and moderately alkaline and calcareous in the underlying material. Permeability is mod-

erately slow, available water capacity is high, and natural fertility is high. The soils are subject to occasional flooding following heavy rain.

Rusco soils are suited to cultivated crops and range. Most of the acreage is cultivated. All locally grown crops are suited.

Representative profile of Rusco silt loam in a cultivated field, 2,350 feet north and 100 feet west of the southeast corner of sec. 9, T. 13 N., R. 9 W.:

Ap—0 to 7 inches, very dark grayish-brown (10YR 3/2) silt loam, very dark brown (10YR 2/2) when moist; weak, medium, subangular blocky structure parting to weak, fine, subangular blocky; slightly hard when dry, friable when moist; neutral; abrupt, smooth boundary.

B2t—7 to 13 inches, grayish-brown (10YR 5/2) silty clay loam, dark brown (10YR 3/3) when moist; moderate, medium, prismatic structure parting to moderate, medium, subangular blocky; slightly hard when dry, friable when moist; mildly alkaline; clear, wavy boundary.

B3—13 to 26 inches, brown (10YR 5/3) silty clay loam, dark brown (10YR 4/3) when moist; moderate, medium, prismatic structure parting to moderate, medium, subangular blocky; slightly hard when dry, friable when moist; mildly alkaline; clear, wavy boundary.

C—26 to 60 inches, light-gray (10YR 7/2) silt loam, light brownish gray (10YR 6/2) when moist; common, medium, faint, reddish-brown mottles; massive; slightly hard when dry, very friable when moist; calcareous, moderately alkaline.

The Ap horizon ranges from silt loam to light silty clay loam in texture and from 7 to 10 inches in thickness. The B horizon ranges from 14 to 32 inches in thickness. It is 28 to 35 percent clay. The C horizon ranges from loam to light silty clay loam.

Rusco soils are associated with Kenesaw and Ortello soils. They differ from those soils in having poorer drainage and in having a B horizon. Also, they are not so coarse textured as Ortello soils.

Rusco silt loam (0 to 1 percent slopes) (Ru).—This soil is in irregularly shaped tracts 5 to 200 acres in size on stream terraces.

Included in mapping are small areas of Kenesaw silt loam, 0 to 1 percent slopes; small areas of Kenesaw-Slickspots complex; and areas where the surface layer has been altered by land leveling.

Runoff is very slow. The main hazard is occasional flooding by water that runs in from adjacent areas. Surface ponding often delays tillage. Crop damage from flooding occurs about once every 5 years. Surface drainage is needed if gravity irrigation is used. Maintaining good tilth and a high level of fertility is a management concern.

Nearly all the acreage is used for cultivated crops; some is irrigated. Corn, sorghum, and alfalfa are the main crops. Small grain is seldom planted because of occasional flooding. This soil is suited to grass and trees and to other less intensive uses. Capability unit IIw-3 dryland, I-12 irrigated; Silty Lowland range site; Moderately Wet windbreak group.

Silty Alluvial Land

Silty alluvial land (0 to 2 percent slopes) (Sy) is stratified alluvium that is commonly silt loam eroded from surrounding uplands. It occurs along deeply entrenched intermittent streams and drainageways. Meandering creek channels bordered by short steep slopes are common.

Runoff is slow, permeability is moderate, and available water capacity is high.

Nearly all the acreage is in native grass, trees, and brush. Use of this land for pasture and as wildlife habitat is limited. Cultivation is not practicable because of the severe hazard of flooding. Capability unit VIw-1 dryland; Silty Overflow range site; Moderately Wet windbreak group.

Silver Creek Series

The Silver Creek series consists of deep, somewhat poorly drained, nearly level to very gently sloping soils on low stream terraces. These soils formed in alluvium. The water table fluctuates between depths of 5 and 8 feet.

In a representative profile, the surface layer is 14 inches thick. It is very dark grayish-brown silt loam in the upper 8 inches and dark-gray silty clay loam in the lower 6 inches. The subsoil is gray, hard heavy silty clay loam about 14 inches thick. The underlying material is light olive-gray silt loam that contains few, fine, distinct, dark-brown mottles in the lower part.

Silver Creek soils are calcareous at or near the surface and are moderately alkaline below. Permeability is moderately slow, available water capacity is high, and natural fertility is high.

Silver Creek soils are suited to cultivated crops and range. Nearly all of the acreage is cultivated, and some is irrigated. Most locally grown crops are suited.

The Silver Creek soils in this county are mapped only with Slickspots.

Representative profile of a Silver Creek silt loam in an area of Silver Creek-Slickspots complex, in native grass pasture, 2,500 feet north and 80 feet west of the southeast corner of sec. 26, T. 13 N., R. 9 W.:

A1—0 to 8 inches, very dark grayish-brown (10YR 3/2) silt loam, black (10YR 2/1) when moist; weak, medium, subangular blocky structure parting to weak, fine, subangular blocky; slightly hard when dry, friable when moist; moderately alkaline; clear, wavy boundary.

A3—8 to 14 inches, dark-gray (10YR 4/1) silty clay loam, very dark gray (10YR 3/1) when moist; weak, medium, subangular blocky structure parting to weak, fine, subangular blocky; hard when dry, friable when moist; calcareous, moderately alkaline; clear, wavy boundary.

B—14 to 28 inches, gray (2.5Y 5/1) heavy silty clay loam, dark gray (2.5Y 4/1) when moist; weak, medium, prismatic structure parting to weak, medium, subangular blocky; hard when dry, friable when moist; calcareous, moderately alkaline; clear, smooth boundary.

C1g—28 to 39 inches, light olive-gray (5Y 6/2) silt loam, olive gray (5Y 5/2) when moist; massive; hard when dry, friable when moist; calcareous, moderately alkaline; clear, smooth boundary.

C2g—39 to 60 inches, light olive-gray (5Y 6/2) silt loam, olive gray (5Y 5/2) when moist; few, fine, distinct, dark-brown mottles; massive; slightly hard when dry, very friable when moist; calcareous, moderately alkaline.

The A horizon ranges from 10 to 18 inches in thickness. The B horizon ranges from 10 to 36 inches in thickness and from silty clay loam to silty clay in texture. The C horizon ranges from silt loam to silty clay loam, and it sometimes

changes to sand below a depth of 4 feet. The Silver Creek soils in Howard County have a water table at a depth of 5 to 8 feet. This is deeper than is defined in the range for the series.

Silver Creek soils are associated with Hord, Kenesaw, Gibbon, and Lamo soils. They have a finer textured B horizon and are more poorly drained than Hord and Kenesaw soils. Their B horizon is finer textured than the soil material at comparable depths in Gibbon soils. They have a thinner A horizon than Lamo soils.

The Silver Creek soils in Howard County are mapped only with Slickspots.

Silver Creek-Slickspots complex (0 to 2 percent slopes) (SS).—This mapping unit is about 65 percent Silver Creek silt loam and 30 percent Slickspots. Hord silt loam, 0 to 1 percent slopes, and Hall silt loam, 0 to 1 percent slopes, make up the remaining 5 percent. These soils are so intermingled that it is not practical to map them separately. They are on stream terraces.

The profile of the Silver Creek soil is similar to the profile described as representative for the Silver Creek series. Slickspots are described under the heading "Slickspots." They occur as alkali areas throughout the complex, mainly in depressions within flat basins 20 to 100 feet in diameter. They are surrounded by Silver Creek soils. In pastures Slickspots appear as microdepressions or buffalo wallows; in cultivated fields they appear as white puddled areas. They are difficult to work.

The main concern of management is the high alkalinity of the Slickspots. Surface drainage is needed. Runoff is slow. Permeability is very slow in the Slickspot areas and the phosphorus content is deficient. When dry, the soils are hard and cloddy. When wet, they are sticky. Farm tractors commonly get stuck in these areas.

This soil unit is used for cultivated crops and range. Most of the acreage is cultivated. Much of it is irrigated. Corn, sorghum, and alfalfa are the main crops. The soils are also suited to trees and to other less intensive uses. Crop growth is more favorable on the Silver Creek part of this complex than on Slickspots. Capability unit IVs-1 dryland, IIIs-1 irrigated; Silver Creek soil in Subirrigated range site and Moderately Wet windbreak group; Slickspots in Saline Lowland range site and Moderately Saline or Alkali windbreak group.

Simeon Series

The Simeon series consists of shallow, excessively drained, nearly level to very gently sloping soils on stream terraces in the Loup River Valleys. These soils formed in sandy alluvium reworked by wind (fig. 7).

In a representative profile, the surface layer is dark-gray loamy sand about 8 inches thick. The underlying material is white, medium and coarse sand that contains some gravel.

Simeon soils are slightly acid in the surface layer to neutral in the underlying material. Permeability is rapid, available water capacity is very low, and natural fertility is low.

Nearly all the acreage is range. These soils are not suited to cultivated crops.

Representative profile of Simeon loamy sand, 0 to 3 percent slopes, in native grass pasture, 0.1 mile south and 300 feet east of the northwest corner of sec. 21, T. 14 N., R. 10 W.:

A—0 to 8 inches, dark-gray (10YR 4/1) loamy sand, very dark brown (10YR 2/2) when moist; weak, very fine, granular structure parting to single grain; soft when dry, very friable when moist; slightly acid; clear, smooth boundary.

AC—8 to 11 inches, grayish-brown (10YR 5/2) medium and coarse sand, dark grayish brown (10YR 4/2) when moist; single grain; loose; neutral; clear, smooth boundary.

C—11 to 60 inches, white (10YR 8/2), medium and coarse sand, light gray (10YR 7/2) when moist; single grain; loose; neutral; 5 to 10 percent by volume of gravel.

The A horizon ranges from loam to sand in texture, from 7 to 19 inches in thickness, and from dark gray to brown in color. The AC horizon ranges from grayish brown to brown in color, from 0 to 6 inches in thickness, and from loamy sand to coarse sand in texture. It contains some gravel.

Simeon soils are associated with O'Neill, Valentine, and Thurman soils. They have a coarse sand C horizon at a depth less than 20 inches, whereas O'Neill soils have sand and gravel at a depth of 20 to 40 inches. Simeon soils have a coarser textured C horizon than Valentine and Thurman soils.

Simeon loamy sand, 0 to 3 percent slopes (Sm).—This soil is in irregularly shaped tracts 3 to several hundred acres in size on stream terraces.

Included in mapping are small areas of Valentine and Thurman soils and some areas that have been eroded by wind.

Runoff is very slow. The main concerns in management are the very low available water capacity and the shallow root zone. Roots do not grow well in the sand and coarse sand underlying material.

This soil is too droughty and unstable for cultivation. All the acreage is in native grass and is used for range and hay. The soil is suited to trees and to other less intensive uses. Capability unit VIs-4 dryland; Shallow to Gravel range site; Shallow windbreak group.

Slickspots

Slickspots is moderately well drained, nearly level to very gently sloping soil material that is strongly alkali or moderately saline. It occurs on stream terraces. The water table fluctuates between depths of 5 and 8 feet.

The surface layer is typically very dark gray silt loam that is about 5 inches thick, but ranges from 1 to 6 inches. Beneath the surface layer is a layer of grayish-brown heavy silty clay loam that is about 9 inches thick, but ranges from 8 to 20 inches and from moderately alkaline to strongly alkaline. The underlying material is light brownish-gray silty clay loam in the upper 10 inches and light olive-gray silt loam below. It has distinct, medium, dark-brown mottles.

Slickspots are moderately alkaline at the surface and strongly alkaline and calcareous below the surface layer. Permeability is slow, available water capacity is moderate, and natural fertility is low.

Slickspots are best suited to range and pasture. Most of the acreage is cultivated. Alkalinity or salinity is the main concern of management. The kinds of crops grown on Slickspots are the same as those grown on associated surrounding soils.

The Slickspots in this county are mapped with Kenesaw and Silver Creek soils. They are more alkaline and saline than those soils.

***Figure 7.*—Profile of Simeon loamy sand, a shallow soil. Medium and coarse sand is at a depth of 11 inches.**

Thurman Series

The Thurman series consists of deep, somewhat excessively drained, nearly level to sloping soils on uplands and stream terraces along the Loup Rivers and east of the Middle Loup River. These soils formed in eolian sand.

In a representative profile, the surface layer is dark-gray loamy fine sand about 10 inches thick. The transitional layer is grayish-brown, loose loamy fine sand about 4 inches thick. The underlying material is fine sand. It is pale brown in the upper 13 inches and light yellowish brown below.

Thurman soils are slightly acid in the surface layer and neutral below. Permeability is rapid, available water capacity is low, and natural fertility is medium to low.

Thurman soils are suited to range and cultivated crops. Most of the acreage is used for crops. Some is in native grass. Most locally grown crops are suited.

Representative profile of Thurman loamy fine sand, 0 to 3 percent slopes, in a cultivated field, 150 feet south and 0.3 mile west of the northeast corner of sec. 15, T. 13 N., R. 11 W.:

Ap—0 to 5 inches, dark-gray (10YR 4/1) loamy fine sand, very dark brown (10YR 2/2) when moist; weak, medium, subangular blocky structure parting to weak, very fine, granular; loose; slightly acid; abrupt, smooth boundary.

A12—5 to 10 inches, dark-gray (10YR 4/1) loamy fine sand, very dark brown (10YR 2/2) when moist; weak, coarse, subangular blocky structure parting to weak, very fine, granular; loose; slightly acid; abrupt, wavy boundary.

AC—10 to 14 inches, grayish-brown (10YR 5/2) loamy fine sand, dark grayish brown (10YR 4/2) when moist; weak, coarse, subangular blocky structure parting to weak, fine, subangular blocky; loose; neutral; clear, wavy boundary.

C1—14 to 27 inches, pale-brown (10YR 6/3) fine sand, brown (10YR 5/3) when moist; weak, medium, subangular blocky structure parting to single grain; loose; neutral; gradual, wavy boundary.

C2—27 to 60 inches, light yellowish-brown (10YR 6/4) fine sand, yellowish brown (10YR 5/4) when moist; single grain; loose; neutral.

The A horizon ranges from loamy fine sand to fine sand in texture and from 10 to 16 inches in thickness. The AC horizon ranges from 3 to 8 inches in thickness and from loamy fine sand to fine sand in texture. The C horizon ranges from loamy sand to fine sand. It is stratified with medium-textured material in some places.

Thurman soils are associated with Valentine and Ortello soils. They have a thicker A horizon than Valentine soils, and a coarser textured AC horizon than Ortello soils.

Thurman fine sand, 0 to 5 percent slopes (TfB).—This soil is in hummocky and irregularly shaped tracts 3 to 100 acres in size on stream terraces. It has a profile similar to the one described as representative for the series, but the surface layer and transitional layer are fine sand. The water table fluctuates between depths of 5 and 8 feet.

Included in mapping are small areas of Elsmere loamy fine sand and Tryon soils, drained.

Runoff is slow. The hazard of soil blowing is severe if the grass cover is removed. Available water capacity is low, and fertility is low. Nearly all the acreage is in native grass and is used for grazing and hay. The soil is well suited to native grass. It is also suited to trees and to other less intensive uses. It is too unstable and coarse textured for cultivated crops. Capability unit VIe–5 dryland; Sandy Lowland range site; Very Sandy windbreak group.

Thurman loamy fine sand, 0 to 3 percent slopes (ThA).—This soil is in irregularly shaped tracts 5 acres to several hundred acres in size on uplands and stream terraces. It has the profile described as representative for the series.

Included in mapping are small areas of Valentine and Thurman soils, 0 to 17 percent slopes; areas of Thurman loamy fine sand, loamy substratum, 0 to 3 percent slopes; and some areas where the surface layer has been altered by land leveling.

Runoff is slow. Soil blowing is a severe hazard on unprotected fields. Available water capacity is low, and fertility is medium. Maintaining good tilth and a high level of fertility is a concern of management.

This soil is suited to cultivated crops and most of the acreage is cultivated. Some of it is irrigated, and some is in native grass. Corn, sorghum, and alfalfa are the main crops. This soil is also suited to trees and to other less intensive uses. Capability unit IIIe–51 dryland, IVe–5 irrigated; Sandy range site; Sandy windbreak group.

Thurman loamy fine sand, 3 to 5 percent slopes (ThB).—This soil is in irregularly shaped tracts 3 acres to several hundred acres in size on uplands and stream terraces. Its profile is similar to the one described as representative for the series, but in many cultivated areas the plow layer is thinner and lighter colored.

Included in mapping are small areas of Valentine and Thurman soils, 0 to 17 percent slopes, and Thurman loamy fine sand, 0 to 3 percent slopes.

Runoff is slow. Soil blowing is a serious hazard on unprotected fields. Available water capacity is low, and fertility is medium. Maintaining good tilth and a high level of fertility is a concern of management.

This soil is suited to cultivated crops, and most of the acreage is cultivated. Some of it is irrigated. Corn, sorghum, and alfalfa are the main crops. This soil is also suited to grass and trees and to other less intensive uses. Capability unit IVe–51 dryland, IVe–51 irrigated; Sandy range site; Sandy windbreak group.

Thurman loamy fine sand, loamy substratum, 0 to 3 percent slopes (2ThA).—This soil is in irregularly shaped tracts 3 to 100 acres in size on stream terraces and uplands. Its profile is similar to the one described as representative for the series, but silt loam or silty clay loam is at a depth of 36 to 48 inches.

Included in mapping are small areas of Valentine and Thurman soils, 0 to 17 percent slopes, and Thurman loamy fine sand, 0 to 3 percent slopes.

Runoff is slow. Soil blowing is a serious hazard on unprotected fields. Available water capacity is moderate. Maintaining good tilth and a high level of fertility is a concern of management.

This soil is suited to cultivated crops, and most of the acreage is cultivated. Corn, sorghum, and alfalfa are the main crops. Some areas are in native grass. This soil is also suited to trees and to other less intensive uses. It is better suited to crops than other Thurman soils because the loamy substratum holds more water within the root zone for most crops. Capability unit IIIe–51 dryland, IVe–5 irrigated; Sandy range site; Sandy windbreak group.

Tryon Series

The Tryon series consists of deep, poorly drained, nearly level to very gently sloping soils on bottom land in the Loup River Valleys. These soils formed in sandy alluvium. The water table fluctuates within a depth of 30 inches.

In a representative profile, the surface layer is very dark-gray loam about 5 inches thick. The transitional layer is light-gray, slightly hard fine sandy loam about 5 inches thick. The underlying material is light-gray fine sand that contains medium, faint, yellowish-brown mottles.

Tryon soils are mildly alkaline throughout the profile. Permeability is rapid, available water capacity is low, and natural fertility is low.

Tryon soils are not suited to cultivated crops. Most of the acreage is in native grass and is used for grazing and hay (fig. 8).

Representative profile of Tryon loam in a native grass meadow, 0.1 mile east and 0.4 mile north of the southwest corner of sec. 34, T. 14 N., R. 10 W.:

A—0 to 5 inches, very dark gray (10YR 3/1) loam, black (10YR 2/1) when moist; weak, fine, granular structure; slightly hard when dry, friable when moist; mildly alkaline; abrupt, wavy boundary.

AC—5 to 10 inches, light-gray (10YR 6/1) fine sandy loam, dark gray (10YR 4/1) when moist; weak, medium, granular structure parting to weak, fine, granular; slightly hard when dry, very friable when moist; mildly alkaline; clear, wavy boundary.

IIC—10 to 60 inches, light-gray (10YR 7/2) fine sand, pale brown (10YR 6/6) when moist; few, medium, faint, yellowish-brown (10YR 5/4) mottles; single grain; loose; mildly alkaline.

The A horizon ranges from silt loam to sandy loam in texture and from 3 to 5 inches in thickness. Thin layers of loamy fine sand occur below the A horizon in many areas. In many areas the IIC horizon has thin layers of medium-textured material.

Tryon soils are associated with Boel, Elsmere, and Ord soils. They have a higher water table than those soils.

Tryon loam (0 to 2 percent slopes) (Ty).—This soil occurs as oblong tracts 5 to 100 acres in size on bottom land. It has the profile described as representative for the series.

Included in mapping are small areas of Tryon soils, drained, and Marsh.

The use of this soil is limited by a high water table. Runoff is slow.

This soil is too wet for cultivated crops. It is used for native hay and range, but in some years forage cannot be harvested because of wetness. Grass and trees grow in some areas. The soil is well suited to windbreak plantings, and it provides suitable aquatic wildlife habitat. Capability unit Vw-1 dryland; Wet Land range site; Very Wet windbreak group.

Tryon soils, drained (0 to 2 percent slopes) (2To).—These soils occur as oblong tracts 5 acres to several hundred acres in size on bottom land and low stream terraces. They have a profile similar to the one described as representative for the series, but the water table is lower. The water table is within a depth of 1 foot in spring and at a depth of 4 feet in summer and fall. The surface layer is silt loam or sandy loam.

Included in mapping are small areas of Tryon loam

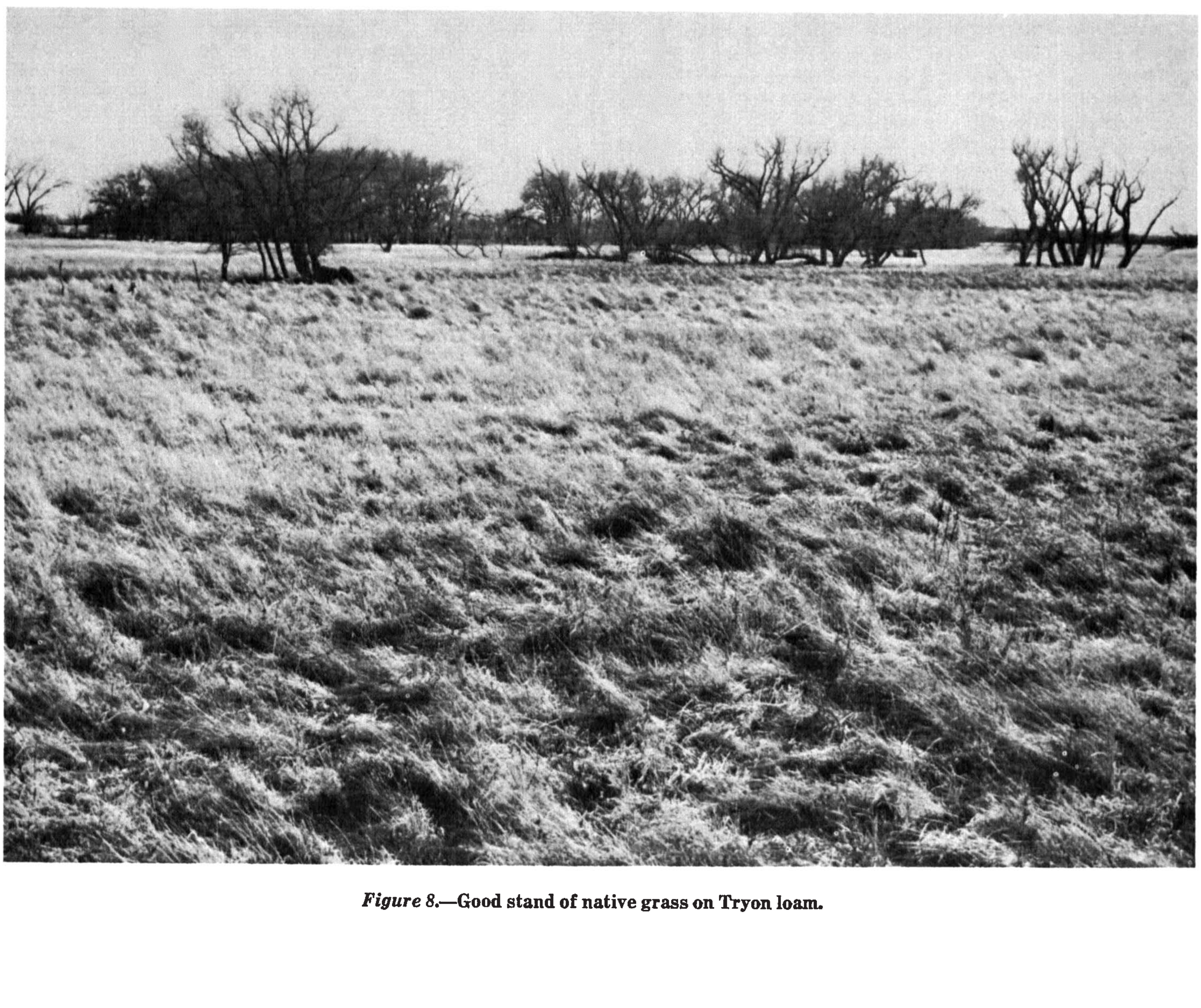

Figure 8.—Good stand of native grass on Tryon loam.

and small areas of Thurman fine sand, 0 to 5 percent slopes, that are shown on the map by a sand spot symbol.

Runoff is slow. The slightly lower water table during the growing season favors the growth of big bluestem, indiangrass, and switchgrass.

These soils are too wet for cultivation, but are suited to trees and other less intensive uses. All the acreage is in native grass and is used for grazing or hay. Capability unit Vw–1 dryland; Subirrigated range site; Moderately Wet windbreak group.

Uly Series

The Uly series consists of deep, well-drained to somewhat excessively drained, sloping to steep soils on the uplands west and north of the Middle Loup River. These soils formed in Peoria Loess.

In a representative profile, the surface layer is dark grayish-brown silt loam about 8 inches thick. The subsoil is about 11 inches thick. It is grayish-brown, slightly hard light silty clay loam in the upper 6 inches and brown, slightly hard silt loam in the lower 6 inches. The underlying material is pale-brown silt loam that contains many, prominent, reddish-brown iron stains.

Uly soils are neutral in the surface layer and upper part of the subsoil and moderately alkaline and calcareous in the lower part and in the underlying material. Permeability is moderate, available water capacity is high, and natural fertility is medium.

Uly soils are suited to range and most locally grown cultivated crops. Nearly all the acreage is in native grass.

Representative profile of Uly silt loam, 5 to 11 percent slopes, in a bromegrass pasture, 100 feet north and 200 feet west of the southeast corner of sec. 2, T. 16 N., R. 10 W.:

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure; slightly hard when dry, friable when moist; neutral; clear, smooth boundary.

B2—8 to 13 inches, grayish-brown (10YR 5/2) light silty clay loam, dark grayish brown (10YR 4/2) when moist; weak, medium, subangular blocky structure parting to weak, fine, subangular blocky; slightly hard when dry, friable when moist; neutral; clear, wavy boundary.

B3—13 to 19 inches, brown (10YR 5/3) silt loam, dark brown (10YR 4/3) when moist; weak, medium, prismatic structure parting to weak, medium, subangular blocky; slightly hard when dry, very friable when moist; calcareous, moderately alkaline; clear, wavy boundary.

C—19 to 60 inches, pale-brown (10YR 6/3) silt loam, brown (10YR 5/3) when moist; many, medium, prominent, reddish-brown iron stains; weak, coarse, prismatic structure; soft when dry, very friable when moist; calcareous, moderately alkaline.

The A horizon ranges from 7 to 10 inches in thickness. The B horizon ranges from 6 to 15 inches in thickness. The depth to lime ranges from 8 to 20 inches.

Uly soils are associated with Holder and Coly soils. They have a thinner and less clayey B horizon than Holder soils. They have a thicker A horizon than Coly soils, and they are deeper over lime.

Uly silt loam, 5 to 11 percent slopes (UsC).—This soil is in tracts 3 acreas to several hundred acres in size on upland hillsides and ridges. It has the profile described as representative of the series.

Included in mapping are small areas of Holder silt loam, 5 to 11 percent slopes, and small eroded areas.

Runoff is medium. Water erosion is a hazard if the grass cover is removed, or if cultivated fields are unprotected.

Nearly all the acreage is in native grass and is used for grazing and hay. The soil is suited to cultivated crops, and it is also suited to trees and other less intensive uses. Capability unit IIIe–1 dryland; IVe–1 irrigated; Silty range site; Silty to Clayey windbreak group.

Uly silt loam, 11 to 15 percent slopes (UsD).—This soil is on hillsides and ridges on the uplands, in areas 3 to 150 acres in size.

Included in mapping are small areas of Uly silt loam, 5 to 11 percent slopes, and Geary soils, 11 to 15 percent slopes, severely eroded.

This soil is somewhat excessively drained, and runoff is rapid. Water erosion is a hazard if the grass cover is removed, or if cultivated fields are unprotected.

Most of the acreage is in native grass and is used for grazing and hay. The soil is not suited to cultivated crops, but is suited to trees and other less intensive uses. Capability unit VIe–1 dryland; Silty range site; Silty to Clayey windbreak group.

Valentine Series

The Valentine series consists of deep, excessively drained, nearly level to strongly sloping soils on uplands and stream terraces south and east of the Middle Loup River. These soils formed in eolian sand.

In a representative profile, the surface layer is dark grayish-brown fine sand about 4 inches thick. The transitional layer is brown, loose fine sand about 7 inches thick. The underlying material is very pale brown fine sand.

Valentine soils are slightly acid in the surface layer and transitional layer and neutral in the underlying material. Permeability is rapid, available water capacity is low, and natural fertility is low.

Most of the acreage is in native grass and is used for grazing or hay. The soils are too sandy and unstable for cultivated crops.

Representative profile of Valentine fine sand, 0 to 17 percent slopes, in an area of Valentine and Thurman soils, 0 to 17 percent slopes, in native grass range, 200 feet south and 0.35 mile west of the northeast corner of sec. 32, T. 15 N., R. 9 W.:

A—0 to 4 inches, dark grayish-brown (10YR 4/2) fine sand, very dark grayish brown (10YR 3/2) when moist; single grain; loose; slightly acid; abrupt, wavy boundary.

AC—4 to 11 inches, brown (10YR 5/3) fine sand, dark brown (10YR 4/3) when moist; single grain; loose; slightly acid; gradual, wavy boundary.

C—11 to 60 inches, very pale brown (10YR 7/3) fine sand, pale brown (10YR 6/3) when moist; single grain; loose; neutral.

The A horizon ranges from 2 to 6 inches in thickness and from dark grayish brown or grayish brown in color. The AC horizon ranges from 0 to 8 inches in thickness and is grayish brown or brown.

Valentine soils are associated with Thurman soils. They have a thinner A horizon and a coarser textured AC horizon than those soils.

Valentine fine sand, rolling (5 to 17 percent slopes) (VaC).—This soil is hummocky. It occurs as irregularly shaped tracts 20 acres to several hundred acres in size on uplands and stream terraces. It has the profile described as representative for the series.

Included in mapping are small areas of Valentine and Thurman soils, 0 to 1 percent slopes, and Blown-out land.

This soil is subject to severe soil blowing if the grass cover is removed. Fertility is low, and available water capacity is low. Runoff is slow.

Nearly all the acreage is in native grass and is used for grazing. The soil is too unstable and too coarse textured for cultivated crops. It is suited to trees and other less intensive uses. Capability unit VIe–5 dryland; Sands range site; Very Sandy windbreak group.

Valentine and Thurman soils, 0 to 17 percent slopes (VTD).—This mapping unit is 60 percent Valentine fine sand, 35 percent Thurman loamy fine sand, and 5 percent Libory, Boelus, and Kenesaw soils. These are nearly level to strongly sloping soils on uplands and streams terraces. Valentine soils are on hummock tops and ridges. Thurman soils are less sloping and are in swales. Both have profiles similar to those described as representative for the respective series. In some areas there are layers of silt loam between depths of 4 and 10 feet.

These soils are subject to severe blowing if the vegetation is removed. Runoff is slow, fertility is low, and available water capacity is low.

These soils are suited only to grass and trees and other less intensive uses. Nearly all the acreage is in native grass that is used for grazing and hay. Capability unit VIe–5 dryland; Sands range site; Very Sandy windbreak group.

Use and Management of the Soils

Approximately 50 percent of Howard County is cultivated, and about 59,000 acres is irrigated. About 44 percent of the county is range. Wheat, grain sorghum, corn, and alfalfa are the major crops. Corn is the principal crop on both dryland and irrigated acreages. There are minor acreages of rye, tame hay, and idle land, which includes summer fallow and the diverted acreage program of government crop controls.

This section explains how the soils can be managed for these purposes. It defines the capability grouping used by the Soil Conservation Service, in which the soils are grouped according to their suitability for crops, and describes use and management for each soil in the county by capability unit. Table 2 shows predicted yields of the principal crops.

This part of the survey also contains information on windbreak plantings and wildlife habitat. In addition, it reports data from engineering tests and interpretations of soil properties that affect highway construction and other engineering structures.

Management of Soils for Crops [2]

Water erosion of the upland soils, flooding of soils adjacent to streams, and loss of fertility by excessive removal of topsoil are the principal concerns of soil management in Howard County. Most of the soils are suitable for crops when these hazards and limitations are reduced or corrected by suitable management practices.

Terraces, contour farming, land leveling, contour bench leveling, and grassed waterways help in controlling water erosion. Keeping crop residue on the surface or growing a protective plant cover, reduces sealing and crusting of the soil during heavy rain. In winter, tall stubble catches drifting snow and provides additional soil moisture.

The hazard of soil blowing can be reduced by the same management that conserves soil moisture, for example, stubble mulch tillage, crop residue, wind stripcropping, and narrow field windbreaks.

The overall hazard of erosion can be reduced if areas of the more productive soils, where the hazard of erosion is slight, are used for row crops and the steeper, eroded soils are used for hay and pasture.

Keeping tillage for seedbed preparation to a minimum and leaving maximum amounts of crop residue on the surface improve the condition of the soil, reduce soil losses, and lessen compaction.

All the soils in Howard County used for crops and pasture should be tested to determine the need for commercial fertilizers. For dryland soils, the kinds and amounts of fertilizer to be applied should be based on the results of soil tests and on the soil moisture content. In areas where the subsoil is dry and rainfall is low, the rate at which fertilizer is applied should be slightly lower than the rate needed for wetter soils. Irrigated soils generally require a larger amount of fertilizer because greater plant production is probable. Nitrogen fertilizer is beneficial on all the soils. Phosphorus and zinc are needed on the eroded Holder, Kenesaw, Coly, and Uly soils.

Land leveling increases the efficiency of irrigation, because an even distribution of water can be obtained, and irrigation runoff can be controlled. Sprinkler irrigation is most satisfactory in leveled areas.

Capability grouping

Capability grouping shows, in a general way, the suitability of soils for most kinds of field crops. The groups are made according to the limitations of the soils when used for field crops, the risk of damage when they are used, and the way they respond to treatment. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to horticultural crops or other crops requiring special management.

Those familiar with the capability classification (*5*) can infer from it much about the behavior of soils when used for other purposes, but this classification is not a substitute for interpretations designed to show suitabil-

[2] Prepared by E. O. PETERSON, conservation agronomist, Soil Conservation Service.

ity and limitations of groups of soils for range, for forest trees, or for engineering.

In the capability system, all kinds of soil are grouped at three levels, the capability class, the subclass, and the unit. These levels are described in the following paragraphs.

Capability Classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical uses, defined as follows:

- Class I soils have few limitations that restrict their use.
- Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.
- Class III soils have severe limitations that reduce the choice of plants, require special conservation practices, or both.
- Class IV soils have very severe limitations that reduce the choice of plants, require very careful management, or both.
- Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use largely to pasture or range, woodland, or wildlife habitat.
- Class VI soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture or range, woodland, or wildlife habitat.
- Class VII soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to pasture or range, woodland, or wildlife habitat.
- Class VIII soils and landforms have limitations that preclude their use for commercial crop production and restrict their use to recreation, wildlife habitat, water supply, or to esthetic purposes.

Capability Subclasses are soil groups within one class; they are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses, because the soils of this class have few limitations. Class V can contain, at the most, only the subclasses indicated by *w*, *s*, and *c*, because the soils in class V are subject to little or no erosion, though they have other limitations that restrict their use largely to pasture or range, woodland, wildlife habitat, or recreation.

Capability Units are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe-1 or IIIw-5. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation; the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraph; and the Arabic numeral specifically identifies the capability unit within each subclass.

In the following pages the capability units in Howard County are described, and suggestions for the use and management of the soils are given. The names of the soil series represented are mentioned in the description of each unit, but this does not mean that all the soils of a given series are in the unit. The capability unit designation for each soil in the county can be found in the "Guide to Mapping Units" at the back of the survey.

CAPABILITY UNIT I-1 DRYLAND, I-1 IRRIGATED

These are deep and moderately deep, nearly level, well-drained soils of the Darr, Grigston, and Hobbs series. They are on bottom land. They have a medium-textured surface layer. Beneath this is medium-textured to moderately coarse textured material. Coarse sand is at a depth of 20 to 40 inches in Darr soils.

These soils are easily worked. Natural fertility is medium to high. The organic-matter content is high. Runoff is slow. Permeability is moderate to moderately rapid. The available water capacity is low in Darr soils, but high in Grigston and Hobbs soils.

Maintaining fertility and the supply of organic matter is the main concern in management. The soils are suited to all the crops commonly grown. Corn, sorghum, small grain, and alfalfa are the main crops.

Dryland management.—These are some of the best soils in the county for the production of crops. Returning crop residue to the soil is about the only management need. Alternating row crops with small grain and hay controls diseases and insects.

Irrigation management.—These soils are suited to all types of irrigation. If irrigated, they are suited to corn, sorghum, and alfalfa, and to tame grasses for hay and pasture. Slight irregularities in the land surface can make uniform distribution of irrigation water difficult. In most places leveling is needed to prepare the soil for gravity irrigation. Leaving crop residue on the surface in winter helps control soil blowing.

CAPABILITY UNIT IIc-1 DRYLAND, I-11 IRRIGATED

In these units are deep, nearly level, well-drained soils of the Hall, Hastings, Holder, Hord, Kenesaw, and Ortello series. These soils are on uplands and stream terraces. The surface layer is medium textured, the subsoil moderately coarse textured to moderately fine textured, and the underlying material medium textured to coarse textured.

These soils are easily worked. Natural fertility is medium to high. The organic-matter content is moderate to high. Runoff is slow. Permeability is moderately slow to moderately rapid. Available water capacity is moderate in Ortello soils and high in the rest.

Dryland management.—The major concern in management is the limited rainfall. Minor concerns are control of water erosion and maintenance of organic matter, high fertility, and good tilth.

Corn, sorghum, small grain, and alfalfa are the main crops suited to these soils. These crops are droughty almost every summer because of limited rainfall. Small grain and the first cutting of alfalfa are generally more dependable crops because they grow and mature in spring when rainfall is highest.

Water erosion can be reduced and moisture conserved by using a cropping system that keeps the soil covered with crop mulches most of the time. Close-growing crops, such as alfalfa, help build up the supply of organic matter and the level of fertility and protect the soil against erosion. Mulching and minimum tillage permit crop plantings without excessive cultivation and without excessive loss of moisture through evaporation.

Irrigation management.—These soils are suited to corn, sorghum, and alfalfa if they are irrigated. In most areas they need some leveling for gravity irrigation. Sustained production can be obtained by using fertilizers, high plant populations, and an efficient irrigation system that controls the amount and time of water application. Uniform distribution of irrigation water and measures to reduce and control irrigation water are essential (fig. 9).

CAPABILITY UNIT IIe-1 DRYLAND, IIe-1 IRRIGATED

In these units are deep, well-drained soils of the Hobbs, Holder, Kenesaw, and Ortello series. These soils are very gently sloping to gently sloping and are on foot slopes, stream terraces, and uplands. The surface layer is medium textured. The subsoil and underlying material are moderately fine textured to coarse textured.

These soils are easily worked. Permeability is moderately slow to moderately rapid. Runoff is medium to slow. Available water capacity in Ortello soils is moderate. It is high in all the other soils. Natural fertility is medium to high. The organic-matter content is moderate to high.

The major concern in management is control of runoff to help conserve moisture. Maintaining good tilth, high fertility, and a high organic-matter content are also essential practices under dryland farming.

Dryland management.—These soils are suited to corn,

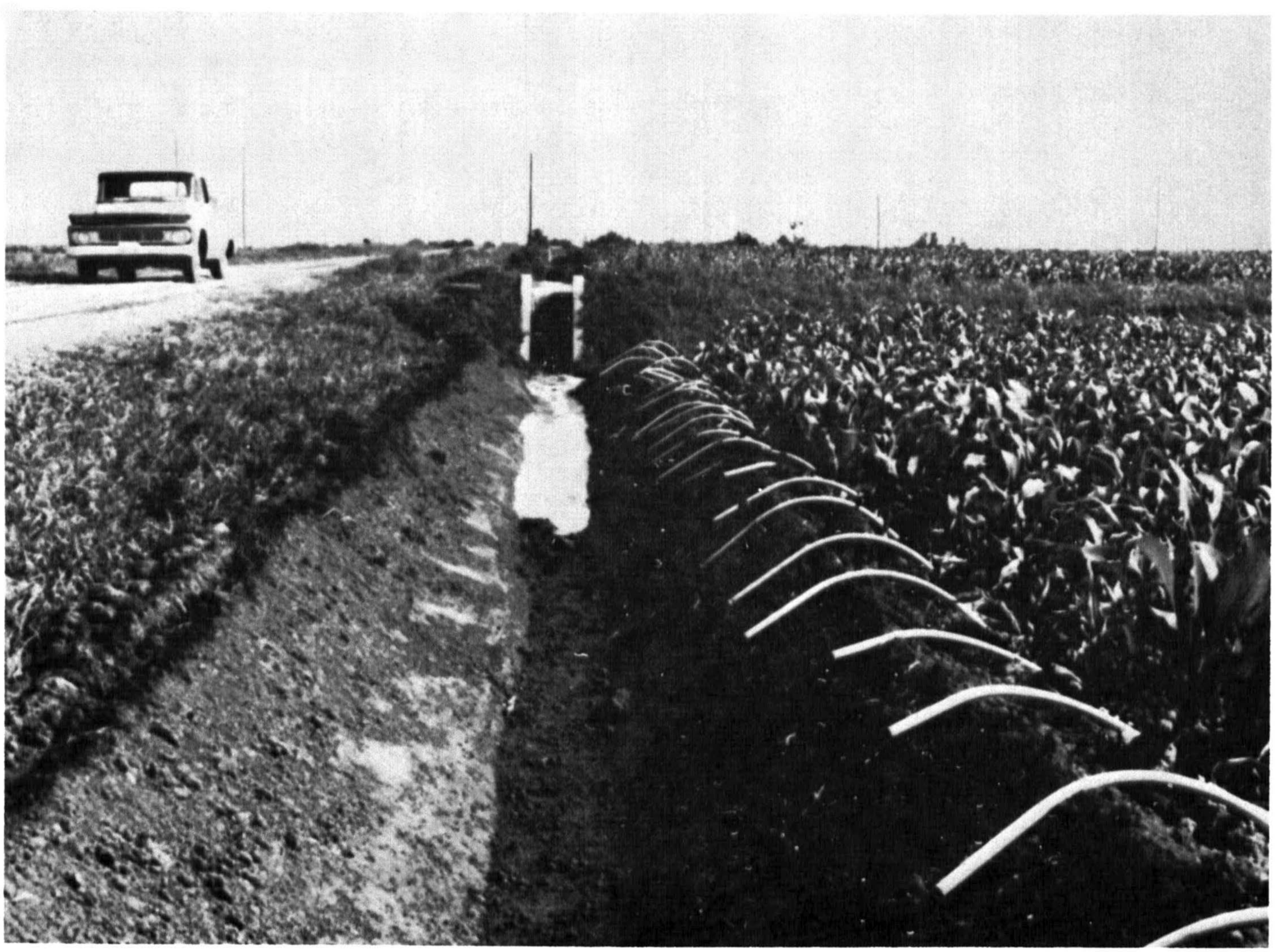

***Figure 9.*—Efficient irrigation on Holder silt loam.**

sorghum, small grain, and alfalfa. Terracing, contour farming, and the use of grassed waterways help in controlling runoff. A cropping system that keeps the soil covered with vegetation most of the time reduces the loss of moisture.

Irrigation management.—Corn, sorghum, alfalfa, and soybeans are the major crops under irrigation. The main hazards are the depletion of soil fertility and the leaching of plant nutrients by excessive irrigation.

For efficient irrigation, the soils can be leveled. Leveling helps to insure even distribution of irrigation water and prevents excessive leaching of nutrients. At regular intervals a legume is needed in the cropping system. Keeping crop residue on the surface of the soil increases water intake and helps control soil blowing.

CAPABILITY UNIT IIe-11 DRYLAND, IIIe-1 IRRIGATED

In these units are deep, well-drained, gently sloping soils of the Hobbs and Holder series. These soils are on foot slopes and uplands. The surface layer is medium textured, and the subsoil and underlying material are moderately fine textured to medium textured.

These soils are easily worked. Permeability is moderately slow to moderate. Runoff is medium. Available water capacity is high. Natural fertility is high. Organic-matter content is moderate to high.

Controlling water erosion is the major concern in management, but conserving moisture and maintaining good tilth, fertility, and organic-matter content are also essential.

Dryland management.—Corn, sorghum, small grain, and alfalfa are the most suitable crops. Terraces, waterways, contour farming, and other mechanical measures help control water erosion. Leaving crop residue on the surface as a mulch is also beneficial.

Irrigation management.—Corn, sorghum, small grain, alfalfa, and tame grasses are suitable crops. Overirrigation increases the hazard of erosion. Contour bench leveling or contour irrigation and terraces can be used with a surface irrigation system. Sprinkler irrigation is also suitable. Careful control of the rate of water application is needed to prevent runoff and soil loss.

Fertility can be maintained by adding barnyard manure and commercial fertilizers. At regular intervals, legumes are needed in the cropping system. Crop residue on the surface provides a protective cover. In most areas where deep cuts have been made in land leveling, the addition of barnyard manure and zinc fertilizer is beneficial.

CAPABILITY UNIT IIe-3 DRYLAND, IIe-3 IRRIGATED

These are deep and moderately deep, well-drained, nearly level to gently sloping soils of the Darr, Loretto, and Ortello series. They are on bottom land, stream terraces, and uplands. The surface layer is moderately coarse textured, and the subsoil and underlying material are medium textured to coarse textured. Coarse sand is at a depth of 20 to 40 inches in the Darr soils.

These soils are easily worked. Permeability is moderate to moderately rapid. The sandy surface layer absorbs rainfall readily. Runoff is medium to slow. Available water capacity is high to low. Natural fertility is medium. The organic-matter content is low to moderate.

Soils in this unit are subject to blowing and water erosion. Controlling erosion is the main concern in management, but conserving moisture and maintaining the organic-matter content and fertility are also essential.

Dryland management.—These soils are suited to corn, sorghum, small grain, and alfalfa. In areas where the available water capacity is moderate and low, they are somewhat droughty during dry cycles.

Water erosion and soil blowing can be reduced and the moisture conserved by stripcropping, stubble mulch tillage, and a cropping system that keeps the soil covered most of the time with grass or crop residue. Row crops can be alternated with small grain and legumes. Terracing, contour farming, and grassed waterways are needed where the soils are used mainly for row crops.

Irrigation management.—These soils are well suited to corn, sorghum, small grain, and alfalfa. The organic-matter content can be maintained by including small grains and legumes in the cropping system and by leaving crop residue on the surface.

Furrows and borders are the most commonly used for irrigating. On gentle slopes where land leveling is costly, sprinklers are suitable. The high water-intake rate of these soils makes it necessary to limit the length of field irrigation runs. Reducing and controlling irrigation runoff at the end of the field is essential for water conservation.

For sustained crop production, commercial fertilizer and barnyard manure are needed.

CAPABILITY UNIT IIw-3 DRYLAND, I-12 IRRIGATED

In these units are deep, well drained to moderately well drained, nearly level to very gently sloping soils of the Hobbs and Rusco series. These soils are on bottom land and stream terraces and are subject to occasional flooding or ponding. The surface layer is medium textured, and the subsoil and underlying material are medium textured or moderately fine textured. Flooding is generally of short duration, and crop damage is seldom severe.

The soils are easily tilled. Permeability is moderate to moderately slow. Runoff is very slow to medium. Available water capacity is high. Natural fertility is high, and the organic-matter content is moderate to high.

The major concern in management is occasional flooding.

Dryland management.—These soils are suited to corn, sorghum, small grain, and alfalfa. Flooding in spring occasionally delays planting and cultivation and limits production of small grain and alfalfa. During dry periods, however, occasional flooding is beneficial to crops because it adds to the moisture supply.

In most areas diversions and drainage ditches are needed to intercept runoff and thus keep it from spreading over a wide area. Clean drainage ditches and diversions intercept flood waters effectively.

Irrigation management.—If irrigated, these soils are better suited to corn and sorghum than to other crops. In areas where flooding is controlled, they are also suited to alfalfa and small grain.

Land leveling and an effective irrigation system are needed to divert and intercept flood waters. Furrow and border irrigation are suitable. Controlling irrigation run-

off at the end of the field is essential. Mulch tillage protects the soil against erosion.

CAPABILITY UNIT IIw-4 DRYLAND, IIw-4 IRRIGATED

In these units are deep, somewhat poorly drained, nearly level to very gently sloping soils of the Boel, Gibbon, Lamo, and Ord series. These soils are on bottom land and low terraces. The surface layer is medium textured, and the transitional layer and underlying material are coarse or moderately fine textured. A water table is at a depth of 2 to 6 feet, and it fluctuates seasonally.

These soils are easily tilled. Permeability is rapid to moderately slow. Runoff is slow. Available water capacity is low to high depending on the depth to fine sand. Natural fertility is medium to high, and the organic-matter content is high.

The major concern in management is wetness during periods when rainfall is above normal.

Dryland management.—These soils are suited to corn, sorghum, and alfalfa. They are poorly suited to small grain and alfalfa because the water table is high in spring. Wetness generally delays tillage and cultivation early in spring.

Diversions, drainage ditches, and tile drains help to control wetness and the high water table.

Irrigation management.—If irrigated, these soils are suited to corn, sorghum, and alfalfa.

Land leveling is needed if furrows and borders are used for irrigating. Land leveling also improves surface drainage. Runs should be short because the water intake rate is moderately rapid in most of these soils, and excessive applications of water leach nutrients to a depth below plant roots.

CAPABILITY UNIT IIw-6 DRYLAND, IIw-6 IRRIGATED

Ord fine sandy loam, the only soil in these units, is a deep, somewhat poorly drained, nearly level soil on bottom land. The surface layer is moderately coarse textured, and it is underlain by moderately coarse textured material. Fine sand is at a depth of 20 to 40 inches. A water table is at a depth of 2 to 6 feet, and it fluctuates seasonally.

This soil is easily worked. Permeability is moderately rapid. The sandy surface layer absorbs rainfall readily. Runoff is slow. Available water capacity is low to moderate depending on the depth to fine sand. Natural fertility is medium, and the organic-matter content is moderate.

The major management concerns are wetness during periods of heavy rainfall, soil blowing in drier periods, and low organic-matter content and fertility.

Dryland management.—Corn, sorghum, and alfalfa are well suited to this soil. Small grain is not so well suited because the water table is high in spring and wetness delays seedbed preparation. The high water table drowns alfalfa in some areas. Where suitable outlets are available, the water table can be lowered by using drainage ditches or tile drains. Growing alfalfa or another close-growing crop at regular intervals is beneficial. Alfalfa eliminates the need for tillage in spring and protects the soil against blowing. Returning crop residue to the soil helps maintain the organic-matter content and also reduces the hazard of soil blowing.

Irrigation management.—The irrigated crops suitable for this soil are corn, sorghum, and alfalfa. Land leveling is needed if furrows and borders are used for irrigating, but deep cuts in leveling are to be avoided. Sprinklers are suitable in areas where leveling is impractical. Small, frequent applications of irrigation water are needed because the available water capacity of this soil is low to moderate.

CAPABILITY UNIT IIs-2 DRYLAND, IIs-2 IRRIGATED

Detroit silt loam, the only soil in these units, is a deep, moderately well drained, nearly level soil on stream terraces. The surface layer is medium textured, the subsoil is fine textured, and the underlying material is medium textured.

Permeability is slow, runoff is slow, available water capacity is high, natural fertility is high, and the organic-matter content is high.

The major concern in management is the claypan subsoil that restricts the penetration of plant roots and slows the intake of water.

Dryland management.—This soil is suited to corn, sorghum, small grain, and alfalfa. Corn and sorghum are generally better suited than other crops, because the soil has slow internal drainage and rainfall is limited.

Growing alfalfa and other close-growing crops improves the tilth and permeability of this soil and keeps the claypan subsoil open. Mulch tillage also improves tilth and permeability and in addition maintains the organic-matter content. Minimum tillage improves permeability by reducing soil compaction.

Intercepting runoff from higher lying soils reduces the hazard of flooding. Attempts to break up the clayey subsoil by mechanical methods are ineffective and costly in most places.

Irrigation management.—Corn and alfalfa are better suited than other crops if this soil is irrigated. Most of the areas need leveling to prepare them for furrow or border irrigation and to provide adequate surface drainage. Irrigation runs can be somewhat longer than on most soils because the water intake rate is moderately slow to slow. Reducing and controlling irrigation runoff at the end of the field is a good water conservation practice.

CAPABILITY UNIT IIs-5 DRYLAND, IIe-11 IRRIGATED

O'Neill loam, 0 to 3 percent slopes, is the only soil in these units. It is a moderately deep, well-drained, nearly level to very gently sloping soil on stream terraces. The surface layer is medium textured, and the subsoil is moderately coarse textured or coarse textured. Fine sand and coarse sand are at a depth of 20 to 40 inches.

This soil is easily worked. Permeability is moderately rapid. Runoff is slow. Available water capacity is low. Natural fertility is medium, and the organic-matter content is moderate.

Conserving moisture, controlling erosion, and maintaining the organic-matter content and fertility are the chief concerns in management. Low available water capacity is a major limitation.

Dryland management.—Corn, sorghum, small grain, and alfalfa are suitable crops. Small grain and first-cutting alfalfa are generally more suitable because they mature in spring when rainfall is more plentiful.

Mulch tillage and a cropping system that keeps the soil covered most of the year conserves moisture, and reduces the hazard of soil blowing. Best results are generally obtained by limiting the years of row crops and including close-growing crops in the cropping system.

Irrigation management.—If irrigated, this soil is well suited to corn and alfalfa. Furrow and border irrigation are suitable in areas where land leveling is practicable. Sprinklers are suitable in other areas.

Frequent, small applications of irrigation water are needed because the soil has low available water capacity.

Efficient irrigation reduces runoff at the end of the fields and prevents excessive leaching.

CAPABILITY UNIT IIs-51 DRYLAND, IIIe-11 IRRIGATED

Inavale loam, the only soil in these units, is a deep, somewhat excessively drained, nearly level to very gently sloping soil on bottom land. The surface layer is medium textured, and the underlying material coarse textured.

This soil is easily worked. Permeability is rapid, runoff is slow, available water capacity is low, natural fertility is low, and the organic-matter content is low to moderate.

Conserving moisture, controlling erosion, and maintaining the organic-matter content and fertility are the chief concerns in management. Low available water capacity is a major limitation.

Dryland management.—Corn, sorghum, small grain, and alfalfa are suitable crops. Small grain and first-cutting alfalfa are generally better suited than other crops because they mature in spring when rainfall is plentiful.

Mulch tillage and a cropping system that keeps the soil covered most of the year conserves moisture and reduces the risk of soil blowing. Best results are generally obtained by limiting the years of row crops and including close-growing crops in the cropping system.

Irrigation management.—Corn and alfalfa are better suited than other crops if this soil is under irrigation. Furrow and border irrigation are effective in areas where land leveling is practicable. Sprinklers are suitable in other areas. Frequent irrigation and small amounts of water are needed on this soil because the available water capacity is low. Measures are needed to reduce the amount of irrigation runoff at the end of the fields and to prevent excessive leaching of soil nutrients.

CAPABILITY UNIT IIIe-1 DRYLAND, IVe-1 IRRIGATED

In these units are deep, well-drained, sloping soils of the Holder, Kenesaw, and Uly series. These soils are on uplands and stream terraces. The surface layer and subsoil are medium textured or moderately fine textured, and the underlying material is medium textured.

These soils are easily worked. Permeability is moderate to moderately slow, runoff is medium, available water capacity is high, natural fertility is high to medium, and the organic-matter content is moderate.

Controlling water erosion is the major management concern. Conserving moisture and maintaining good tilth, fertility, and the organic-matter content are also essential.

Dryland management.—Corn, sorghum, small grain, and alfalfa are well suited to these soils. Crops are subject to damage almost every summer because rainfall is limited.

Terraces, grassed waterways, contour farming, and a mulch of crop residue reduce the rate of runoff and the hazard of erosion (fig. 10).

Water erosion can be reduced and moisture conserved by using a cropping system that keeps the soil covered with crops or crop residue most of the time. Limiting the years of consecutive row crops, managing the crop residue, and increasing the number of close-growing crops in the cropping system are suggested practices.

Minimum tillage and mulch tillage during seedbed preparation are effective in erosion control. Gullied areas can be shaped and seeded to grasses. Grassed field borders help control runoff, and they can also be used as turn rows, roadways, and wildlife areas.

Irrigation management.—Alfalfa and grasses are better suited than other crops if these soils are irrigated. Corn is suited if erosion control is practiced. Terraces, contour irrigation, waterways, and crop residue on the surface of the soil reduce the hazard of erosion in irrigated areas.

Soil fertility can be improved by using commercial fertilizers and manure.

Sprinkler irrigation is suitable. Controlling erosion is difficult in sloping areas. The rate at which water is applied should not exceed the water intake rate. Contour bench leveling is a suitable method of controlling erosion in gently sloping areas.

CAPABILITY UNIT IIIe-3 DRYLAND, IIIe-3 IRRIGATED

Inavale fine sandy loam is the only soil in these units. It is a deep, somewhat excessively drained, nearly level to gently sloping soil on bottom land. The surface layer is moderately coarse textured. Beneath this is coarse-textured underlying material.

This soil is easily worked. Permeability is rapid, the surface layer absorbs rainfall readily, runoff is slow, available water capacity is low, natural fertility is low, and the organic-matter content is low.

The soil in this unit is subject to blowing and water erosion. Controlling erosion is the major concern in management, but conserving moisture and maintaining the organic-matter content and fertility are also essential.

Dryland management.—Corn, sorghum, small grain, and alfalfa are suitable crops. Because of the low available water capacity, this soil is somewhat droughty.

The hazards of soil blowing and water erosion can be reduced and the moisture conserved by stripcropping, mulch tillage, and a cropping system that keeps the soil covered with residue most of the time.

Irrigation management.—Suitable crops for this soil under irrigation are corn, small grain, sorghum, alfalfa, and grasses. Furrows and borders are used for irrigating the nearly level to very gently sloping soils. Sprinklers are suited to the gentle slopes where leveling would be impractical. Irrigation water can be managed more efficiently on fields that have been leveled.

In places where deep cuts expose the sandy underlying material, irrigation is needed frequently because the available water capacity is low. Excessive water leaches nutrients to a level below the plant roots. Controlling irrigation runoff conserves water.

***Figure 10.*—Grassed waterway on Holder silt loam.**

CAPABILITY UNIT IIIe-5 DRYLAND, IIIe-5 IRRIGATED

In these units are deep, excessively drained to well drained, nearly level to gently sloping soils of the Boelus, Inavale, Libory, and Ortello series. These soils are on bottom land and stream terraces. The surface layer is coarse textured, and the subsoil and underlying material range from coarse textured to medium textured.

These soils are easily worked. Permeability is rapid to moderate. The sandy surface layer absorbs rainfall readily. Runoff is slow to medium, available water capacity is low to high, natural fertility is low to medium, and the organic-matter content is low to moderately low.

All soils in these units are subject to blowing unless they are properly managed. Controlling erosion is the major concern in management, but conserving moisture and maintaining the organic-matter content and fertility are also essential.

Dryland management.—Corn, sorghum, small grain, and alfalfa are suited to these soils. Small grain and first-cutting alfalfa are generally the most dependable crops because they grow and mature in spring when rainfall is plentiful.

A cropping system that keeps the soil covered with crop residue most of the time reduces soil blowing, conserves moisture, and maintains the organic-matter content and fertility. Limiting the number of consecutive years of row crops and including close-growing crops in the cropping system protect the soil and conserve moisture. Alternating close-growing crops and row crops in narrow strips and planting narrow, tree windbreaks help control soil blowing.

Irrigation management.—Corn and alfalfa are well suited to these soils. Small grain, grasses, and legumes are also suited.

Furrows, borders, and sprinklers are suitable. Leveling is needed if furrows and borders are used. Deep cuts during land leveling should be avoided because of the danger of exposing the sandy underlying material. Libory-Boelus soils are more suitable for leveling than Inavale soils. Growing a cover crop or keeping crop residue on the surface helps control soil blowing. Light, frequent applications of irrigation water are needed. Excessive water leaches fertilizers below the plant roots.

CAPABILITY UNIT IIIe-51 DRYLAND, IVe-5 IRRIGATED

In these units are deep, somewhat excessively drained, nearly level to very gently sloping soils of the Thurman series. These soils are on stream terraces and uplands. The surface layer is coarse textured, and the underlying material is coarse textured.

These soils are easily worked. Permeability is rapid. The sandy surface layer absorbs rainfall readily. Runoff is slow, available water capacity is low, natural fertility is medium, and the organic-matter content is medium.

Soil blowing is the major limitation. Improving fertility and increasing the supply of organic matter should be considered in management.

Dryland management.—Corn, sorghum, small grain, and alfalfa are well suited to these soils. Soil blowing can be controlled, moisture conserved, and the organic-matter content and fertility maintained if the soils are covered most of the time with crops, grass, or crop residue. Limiting the consecutive years of row crops, including close-growing crops and legumes in the cropping system, and using narrow tree windbreaks should be considered in management.

Irrigation management.—These soils are well suited to corn and alfalfa and are suited to small grain, sorghum, and grasses.

Sprinklers can be used in irrigating. Frequent irrigation is needed. The rapid permeability of the soils limits the use of border and furrow irrigation systems.

CAPABILITY UNIT IIIw-5 DRYLAND, IIIw-5 IRRIGATED

In these units are deep, somewhat poorly drained, nearly level to very gently sloping soils of the Boel, Elsmere, and Ovina series. These soils are on bottom land and stream terraces. The surface layer is coarse textured, and the underlying material is coarse textured to medium textured. The water table fluctuates seasonally between depths of 2 and 6 feet.

These soils are easily worked. Permeability is moderate to rapid. The sandy surface layer absorbs rainfall readily. Available water capacity is low to moderate, natural fertility is medium, and the organic-matter content is moderate.

The major concern in management is seasonal wetness, but soil blowing in drier periods and low organic-matter content and fertility are also concerns.

Dryland management.—Corn, small grain, and sorghum are suited to these soils. Alfalfa is suited in areas where the water table is not too high.

These soils are hard to work in spring because the high water table keeps the surface wet. Alfalfa and other closing-growing crops eliminate the need for working these soils in spring and protects them against blowing when the surface is dry. The hazard of soil blowing can also be reduced by stubble mulch tillage and a cropping system that keeps the soil covered with crop residue most of the time. Returning crop residue to the soil helps to maintain and improve the organic-matter content, and commercial fertilizers and manure maintain and improve fertility.

Irrigation management.—If the water table is not too high, corn, sorghum, and alfalfa are well suited to these soils under irrigation.

Furrows and borders are commonly used for irrigating. Sprinklers are also suitable. Land leveling is needed for furrow irrigation, but deep cuts that expose the underlying material are to be avoided. Short irrigation runs are needed because permeability is rapid. More frequent irrigation is needed in summer when the water table is naturally lower. Excessive irrigation water should be avoided because it leaches plant nutrients below the root zone.

In some places drainage ditches or tile drains are used to lower the water table, especially in spring when the water level is naturally high.

CAPABILITY UNIT IIIw-6 DRYLAND, IIw-61 IRRIGATED

Boel fine sandy loam is the only soil in these units. This is a deep, somewhat poorly drained, nearly level to very gently sloping soil on bottom land. The surface layer is moderately coarse textured, and the underlying material is coarse textured. The water table is at depths of 2 to 6 feet. It fluctuates seasonally.

This soil is easily tilled. Permeability is rapid. The sandy surface layer absorbs rainfall readily. Runoff is slow, available water capacity is low, natural fertility is medium, and the organic-matter content is moderate. The major concern in management is seasonal wetness. Maintaining the organic-matter content and controlling soil blowing in dry seasons are needed practices.

Dryland management.—Corn, sorghum, and alfalfa are the main crops suited to this soil; small grain is not so well suited because the water table is high in spring. In areas where the water table is extremely high, alfalfa is not suitable.

In cultivated areas, this soil is generally hard to work in spring because the high water table keeps the surface wet. A close-growing crop eliminates the need for working this soil in spring and protects it from soil blowing when the surface is dry. Mulch tillage and returning crop residue to the soil improve the organic-matter content. Commercial fertilizers maintain and improve fertility.

Irrigation management.—Under irrigation, this soil is suited to corn, sorghum, and alfalfa. Irrigating with furrows and borders is suitable, but land leveling is needed. Deep cuts in leveling should be avoided. Irrigating with sprinklers is also suitable. Frequent, small applications of water are most effective.

In some areas drainage ditches help lower the water table.

CAPABILITY UNIT IVe-5 DRYLAND

In this unit is the complex, Libory-Boelus fine sands. These soils are deep, well drained to moderately well drained, and nearly level to very gently sloping. They are on stream terraces. The surface layer is coarse textured, and the subsoil and underlying material are medium textured.

These soils are easily tilled. Permeability is moderate. The sandy surface layer absorbs rainfall readily. Runoff is slow, the available water capacity is high, natural fertility is medium, and the organic-matter content is low to moderate.

The major concern in management is soil blowing. Conserving moisture and maintaining the organic-matter content and fertility are also essential.

Dryland management.—Crops well suited to these soils are corn, sorghum, small grain, grass and alfalfa. Small grain and first-cutting alfalfa are generally better suited because they grow and mature in spring when rainfall is plentiful. The hazard of soil blowing can be reduced by alternating narrow strips of field crops or row crops with close-growing crops, using narrow plantings of trees as windbreaks, and keeping the soil covered with vegetation or crop residue most of the time. Planting a row crop in spring and then interplanting with rye and hairy vetch early in fall keeps crop residue on these soils at all times.

Soil fertility is improved by the use of commercial fertilizers.

These soils are not suitable for irrigation. Even applications of water are difficult because the surface layer is coarse textured.

CAPABILITY UNIT IVe-51 DRYLAND, IVe-51 IRRIGATED

Thurman loamy fine sand, 3 to 5 percent slopes, is the only soil in these units. This is a deep, somewhat excessively drained, gently sloping soil on uplands. The surface layer and the underlying material are coarse textured.

This soil is easily tilled. Permeability is rapid. Runoff is slow, available water capacity is low, natural fertility is medium, and the organic-matter content is medium to low.

This soil is subject to severe soil blowing unless it is properly managed. The major concern in management is soil blowing. Conserving moisture and maintaining the organic-matter content and fertility are also essential practices.

Dryland management.—Corn, sorghum, small grain, and alfalfa are well suited to this soil. Small grain and the first cutting of alfalfa are generally the better suited crops because they grow and mature in spring when rainfall is plentiful. Starting crops on this soil is sometimes difficult because soil blowing destroys many young plants early in spring.

Soil blowing can be reduced, moisture conserved, and organic-matter content and fertility maintained by using a cropping system that keeps the soil covered with crops, grass, or crop residue. In cultivated areas, good results are generally obtained by limiting the plantings of row crops and increasing close-growing crops to protect the soil and conserve moisture. Soil blowing can also be reduced by stripcropping, mulch tillage, grassed field borders, and narrow tree windbreaks.

Irrigation management.—This soil can be irrigated. It is suited to corn, sorghum, small grain, and alfalfa. Plant populations can be maintained at a higher level than in dryland areas. Sprinkler irrigation is well suited to this soil. Frequent water applications are needed because the available water capacity is low, and light applications are needed to avoid excessive leaching of plant nutrients.

Soil blowing can be reduced by alternating narrow strips of row crops with small grain, alfalfa, or other close-growing crops. Protecting the soil with crop mulches reduces the hazard of soil blowing.

CAPABILITY UNIT IVe-8 DRYLAND

In this unit are deep, well-drained, sloping soils of the Coly and Geary series. These soils are on uplands. The surface layer, subsoil, and underlying material are medium textured or moderately fine textured.

These soils are easily tilled. Permeability is moderate or moderately slow. Runoff is medium to rapid, available water capacity is high, natural fertility is low, and the organic-matter content is low.

The soils of this unit are subject to severe water erosion. Major management concerns are controlling water erosion and conserving moisture. Maintaining and improving the organic-matter content and fertility are other management concerns.

Dryland management.—Soils in this unit are not well suited to cultivated crops because runoff after rainfall results in moisture loss and severe water erosion. They are better suited to small grain, grass, and alfalfa. Converting the acreage to range by reseeding native grasses is one of the better uses for this soil. Because of the erosion hazard, these soils are not suited to irrigation.

Terraces, grassed waterways, contour farming, and crop residue left on the surface help control runoff and erosion. The better cropping system is one of small grain, grass, alfalfa, and other hay crops. Mulch farming and returning crop residue to the soil improves the organic-matter content.

Shaping and seeding gullied areas, using grassed waterways, and providing a good grass cover are practices needed on the more severely eroded and gullied areas. Grassed field borders help control runoff at the end of the field, and they can be used as turn rows, roadways, and wildlife habitat. If these soils are used as range, an adequate cover of vegetation is needed to reduce runoff and help control erosion.

CAPABILITY UNIT IVe-81 DRYLAND, IVe-11 IRRIGATED

Holder silty clay loam, 5 to 11 percent slopes, severely eroded, is the only soil in these units. It is a deep, well-drained soil on uplands. The surface layer and subsoil are moderately fine textured. The underlying material is medium textured.

This soil is easily worked. Permeability is moderately slow. Runoff is medium, available water capacity is high, natural fertility is medium, and the organic-matter content is low to moderately low.

This soil is subject to severe water erosion. Controlling erosion is the major concern in management. Conserving moisture and maintaining good tilth, fertility, and the organic-matter content are also concerns.

Dryland management.—This soil is suited to corn, sorghum, small grain, and alfalfa. Crops are subject to damage almost every summer because of limited rainfall.

Terraces, grassed waterways, contour stripcropping, and use of crop residue are practices needed to control runoff and erosion. The hazard of water erosion can also be reduced and moisture conserved by using a cropping

system that keeps the soil covered with crop residue most of the time. The best results are obtained by limiting the row crop to 1 year and including in the cropping system some close-growing crops that protect the soil against erosion. Returning crop residue to the soil helps to maintain and improve the organic-matter content and tilth. This soil can also be reseeded to grasses and converted to range or pasture.

Irrigation management.—Sprinklers can be used for irrigation. The steeper slopes are difficult to manage under surface irrigation. Contour bench leveling is possible on the lesser slopes, but the cost is high, and maintenance of high bench escarpments is difficult. The rate at which water is applied should be equal to or below the intake rate of this soil.

Under irrigation this soil is suited to grass and alfalfa, small grain, and a limited amount of corn or sorghum, but it is better suited to grass or legumes. Terraces, grassed waterways, and contour farming are beneficial practices in areas where these soils are irrigated by sprinklers.

Shaping and seeding gullied areas and keeping a good cover of grass in the waterways are needed management practices. Grassed field borders help control runoff. Also, they can be used as turn rows, roadways, and wildlife habitat.

CAPABILITY UNIT IVs-1 DRYLAND, IIIs-1 IRRIGATED

In these units are well-drained, to somewhat poorly drained, nearly level to very gently sloping soils of the Kenesaw and Silver Creek series, and Slickspots, a land type. These soils are on stream terraces. The surface layer is medium textured, the subsoil is fine textured to medium textured, and the underlying material is medium textured. The water table in most places is below a depth of 5 feet. The areas of Slickspots are moderately alkali. The soil material in Slickspots is puddled, and the surface is covered with salts during some periods.

Kenesaw and Silver Creek soils are easily worked. Slickspots are difficult to work. Permeability of Kenesaw and Silver Creek soils is moderate to moderately slow. Permeability of Slickspots is slow, and they are sticky when wet and cloddy when dry. Runoff is slow, available water capacity is high to medium, natural fertility is low to high, and the organic-matter content is low to high.

The major concern in management is managing the alkalinity of these soils.

Dryland management.—These soils are not well suited to cultivation because they are alkaline. Corn, sorghum, small grain, alfalfa, and alkali-tolerant grasses can be grown. Small grain and the first cutting of alfalfa generally are better suited crops because they grow and mature in spring when rainfall is more frequent.

Good management is needed in cultivated areas because the slickspot areas are droughty, have poor tilth and slow permeability, and contain salts that are toxic to some crops. The salts cause poor structure and slow permeability that increases the rate of runoff. Chemicals can be added to reduce the effect of the salts and alkali. Best results are generally obtained by growing the more salt-tolerant crops and using a cropping system that keeps the soil covered with vegetation most of the time to prevent evaporation.

Irrigation management.—Corn, sorghum, small grain, alfalfa, and alkali-tolerant grasses are some of the irrigated crops suited to these soils. Furrow, border, and sprinkler irrigation are suitable. If furrows and borders are used, leveling is needed to provide better surface drainage and more even distribution of water. In areas where the water table is high, soil drainage can be provided by drainage ditches or tile drains. Chemicals can be used to reduce the effects of the salts and alkali. Barnyard manure and other forms of organic matter can be incorporated into the soil to make it more friable and more absorbent to water.

CAPABILITY UNIT Vw-1 DRYLAND

In this unit are the deep, poorly drained, nearly level to gently sloping soils of the Tryon series. These soils are on bottom lands. The surface layer is medium textured to moderately coarse textured. The underlying material is coarse textured. The water table fluctuates between the surface and a depth of 3 feet.

Permeablity is rapid, runoff is slow, available water capacity is low, and natural fertility is low. The organic-matter content is moderate to high.

A major hazard is the excessive wetness. These soils are not suited to cultivation because they are too wet, and drainage is generally not practicable.

Dryland management.—Nearly all the acreage is used for permanent hay or pasture. Proper stocking and deferred grazing help maintain and increase grass production and prevent the development of boggy areas. Boggy conditions develop in pastures that are grazed when the water level is at the surface (fig. 11).

Many areas adjacent to the river are densely wooded. There is a possibility of increasing grass production on these areas by introducing reed canarygrass or other grasses that tolerate wetness. These areas are also suitable as wildlife habitat.

CAPABILITY UNIT VIe-1 DRYLAND

Uly silt loam, 11 to 15 percent slopes, is the only soil in this unit. It is a deep, well-drained, strongly sloping soil on uplands. The surface layer and the subsoil are medium textured. The underlying material is calcareous loess.

Permeability is moderate, available water capacity is high, and runoff is rapid. This soil releases moisture readily to plants.

Dryland management.—This soil is suited only to range, hay, trees, and other less intensive uses. It is not suited to cultivated crops because the hazard of water erosion is severe on the strong slopes.

Proper stocking, deferred grazing, and control of weeds and brush help to maintain and improve stands of grass. Dams along the drainageways can be used to impound water for livestock or for recreational purposes.

CAPABILITY UNIT VIe-3 DRYLAND

Only Ortello-Coly complex, 15 to 31 percent slopes, is in this unit. The soils in this complex are deep and well drained to excessively drained. They are on uplands. The surface layer is moderately coarse textured or medium

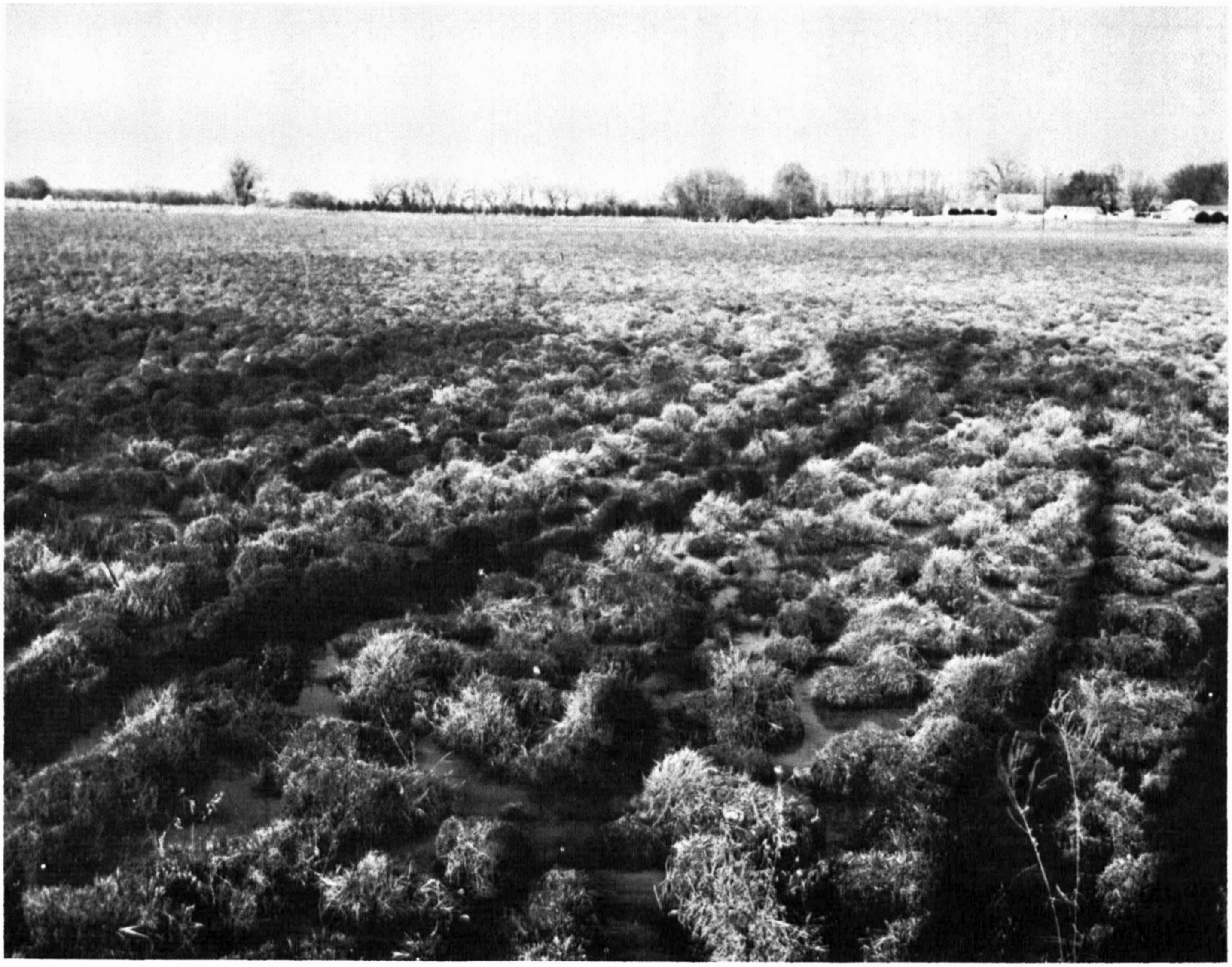

Figure 11.—**Boggy condition on Tryon loam.**

textured, and the subsoil and underlying material are coarse textured to medium textured.

Permeability is moderately rapid to moderate, runoff is medium to rapid, available water capacity is moderate to high, natural fertility is medium to low, and the organic-matter content is moderate to low.

The major concern in management is control of runoff and erosion. These soils are subject to severe water erosion and soil blowing if they are overgrazed or if the surface is left unprotected.

Dryland management.—These soils are poorly suited to cultivation because they are too steep and erodible. They are well suited to grass, trees, and plantings for wildlife habitat and recreational areas.

The entire acreage is used for permanent pasture. Proper stocking, deferred grazing, and control of weeds and brush help to maintain and increase grass production. Stock water and erosion control dams can be built in these areas if sites are carefully selected.

CAPABILITY UNIT VIe-5 DRYLAND

In this unit are deep, somewhat excessively drained to excessively drained, nearly level to strongly sloping soils of the Inavale, Thurman, and Valentine series. These soils are on bottom land, stream terraces, and uplands. The surface layer is coarse textured, and the transitional layer and underlying material are coarse textured.

Permeability is rapid, runoff is slow, available water capacity is low, natural fertility is low, and the organic-matter content is low or medium.

Soils in this unit are subject to severe blowing if they are overgrazed or if the surface is left unprotected. The major concern in management is the control of soil blowing and the maintenance of the organic-matter content and fertility.

Dryland management.—These soils are poorly suited to cultivation because they are sandy, droughty, and erodible. They are well suited to grass. Proper stocking,

deferred grazing, rotation grazing, and control of weeds and brush are needed to maintain grass yields.

Most of the acreage is used for permanent hay or pasture. The soils are also suited to trees and to the development of wildlife habitat and recreation areas. Areas that are cultivated can be seeded to grass and then used for hay or pasture.

CAPABILITY UNIT VIe-8 DRYLAND

In this unit are deep, well-drained to excessively drained, strongly sloping to steep soils of the Coly, Geary, and Nuckolls series. These soils are on the uplands. The surface layer, the subsoil, and underlying material are medium textured to moderately fine textured.

Permeability is moderate to moderately slow, runoff is rapid, available water capacity is high, natural fertility is low, and the organic-matter content is low.

These soils are subject to severe water erosion, and the control of runoff and erosion is the major concern in management.

Dryland management.—These soils are not suitable for cultivation because they are too steep and erodible. Most of the acreage is cultivated. Reseeding cultivated areas to native grass and converting them to range is a good use for these soils. Good management is needed if a good grass cover is to be established and maintained. Proper stocking, deferred grazing, and control of weeds and brush all help in establishing and maintaining a good grass cover. A good grass cover reduces runoff and the hazard of erosion and conserves moisture.

Dams for livestock water, erosion control, and flood detention reservoirs can be built in the bottom of the drainageways. These soils are also suited to trees and to the development of wildlife habitat and recreation areas.

CAPABILITY UNIT VIe-9 DRYLAND

In this unit are deep, somewhat excessively drained to excessively drained, gently sloping to steep soils of the Coly series. These soils are on uplands. The surface layer is medium textured, and the subsoil and underlying material are medium textured.

Permeability is moderate, runoff is rapid, available water capacity is high, natural fertility is medium to low, and the organic-matter content is low to moderate.

The major concern in management is the control of runoff and erosion. These soils are subject to severe water erosion if they are overgrazed or if the surface is left unprotected during the time of seedbed preparation.

Dryland management.—These soils are poorly suited to cultivated crops because they are too steep and erodible. Most of the acreage is in native grass and is used for grazing or for hay production. Proper stocking, deferred grazing, and the control of weeds and brush are needed to help maintain and increase the grass yields. A good grass cover also reduces runoff and the hazard of erosion and helps to maintain the organic-matter content and fertility.

The small areas that are now under cultivation are severely eroded. These areas can be retired from cultivation, seeded to grass, and converted to range for grazing purposes. These soils are also suited to trees and to the development of wildlife habitat and recreation areas.

Dams for livestock water, erosion control structures, and flood detention reservoirs can be built in the bottoms of drainageways.

CAPABILITY UNIT VIw-1 DRYLAND

Only Silty alluvial land, a land type, is in this unit. It is deep, nearly level, frequently flooded soil material on bottom land. The surface layer and underlying material are medium textured. This land is cut by deeply entrenched, intermittent streams that overflow frequently and flood adjacent areas. Floodwaters generally cover this land for only short periods, but long enough to prevent using the areas for cultivated crops.

Permeability is moderate, surface runoff is slow, available water capacity is high, natural fertility is low, and the organic-matter content is high to low.

The hazards in this unit are the frequent flooding and the inaccessibility because of entrenched stream channels.

Dryland management.—This land type is not suitable for cultivation because it is broken into small units by deeply entrenched stream channels and is flooded after heavy rain. It is well suited to grass, trees, and the development of wildlife habitat and recreation areas.

Most of this unit is used for permanent pasture. Proper stocking, deferred grazing, and the control of weeds and brush help to maintain and increase grass yields. In many areas there is very little grass because this land is covered with trees or is dissected by entrenched stream channels.

Erosion control structures can be built if sites are carefully selected. Large flood detention reservoirs can be used to reduce flooding in areas below the structures.

CAPABILITY UNIT VIs-4 DRYLAND

Simeon loamy sand, 0 to 3 percent slopes, the only soil in this unit, is a shallow, excessively drained, nearly level to very gently sloping soil on stream terraces. The surface layer is coarse textured, and the underlying material, at a depth of 10 to 20 inches, is medium and coarse sand.

Permeability is rapid, runoff is slow, available water capacity is very low, natural fertility is low, and the organic-matter content is low.

This soil is subject to severe soil blowing if it is overgrazed or if the surface is left unprotected. The major concern in management is the control of the soil blowing.

Dryland management.—This soil is not suitable for cultivation because it is sandy, shallow, droughty, and erodible.

Most of the acreage is used for permanent pasture. Proper stocking, deferred grazing, and the control of weeds and brush help to maintain and increase the grass cover and reduce soil blowing.

This soil is also suited to trees and to the development of wildlife habitat and recreation areas.

CAPABILITY UNIT VIIe-1 DRYLAND

Only Rough broken land, loess, is in this unit. It is deep, excessively drained soil material on the uplands. It has very steep slopes and catstep topography. The soil material is medium textured. Permeability is moderate, runoff is very rapid, available water capacity is high,

natural fertility is low, and the organic-matter content is low to moderate.

The major concern in management is controlling runoff and water erosion.

Dryland management.—This land type is not suitable for cultivation because it is too steep and erodible. It is suited only to grass, trees, and the development of wildlife habitat and recreation areas.

Most of the acreage is used for permanent pasture. A good cover of grass and deferred grazing reduce water erosion and conserve moisture on these very steep slopes.

Dams for livestock water, and erosion control structures can be built in the bottoms of drainageways.

CAPABILITY UNIT VIIe-5 DRYLAND

Only Blown-out land, a land type, is in this unit. It is deep, excessively drained, sloping to strongly sloping, coarse-textured soil material on the uplands.

Permeability is rapid, runoff is slow, available water capacity is low, natural fertility is low, and the organic-matter content is low.

The major concern in management is the control of soil blowing.

Dryland management.—This land type is not suitable for cultivation because it is sandy, droughty, and very erodible. It is suited only to grass and trees and to the development of wildlife habitat and recreation areas.

This land type produces no appreciable vegetation. Vegetation can be established, and these blow-outs can be stabilized by fencing out livestock and by shaping, reseeding, and mulching. Grazing has to be carefully controlled to avoid the recurrence of soil blowing.

CAPABILITY UNIT VIIIw-1 DRYLAND

The land type, Marsh, is in this unit. It is very poorly drained and is under open water most of the time. Marsh is nearly level and on bottom lands. The soil material is medium textured to coarse textured.

Permeability is rapid. There is no runoff.

Dryland management.—This land type is not suited to cultivated crops, grass, or trees, but it is suitable as wildlife habitat and recreational areas. It supports cattails, rushes, sedges, and other aquatic plants.

Livestock can utilize very little of this vegetation.

Predicted yields

Table 2 shows the predicted average yields per acre of the principal crops of Howard County. The predicted yields are given for both dryland and irrigation crops under two levels of management. The yields in columns A are those expected under common or average management. Yields in columns B are those expected under improved or high-level management.

High-level management includes such practices as–

(1) Using conservation practices that control soil blowing and water erosion.
(2) Maintaining organic-matter content and good tilth by using a suitable cropping system and utilizing crop residue.
(3) Using good tillage methods.
(4) Planting suitable crop varieties in proper quantities.
(5) Controlling ground water level in wetter soils.
(6) Applying fertilizer and lime according to needs indicated by soil tests.
(7) Using insect and disease controls consistently.
(8) Applying irrigation water efficiently by preparing fields properly for the type system to be used.
(9) Performing all practices at the proper time.

The yields predicted in table 2 are based on information obtained from the Nebraska Agricultural Statistics; from information furnished by the farmers, County Extension Agent, Soil Conservation District Supervisors; and on observations made by agricultural workers and others who are familiar with the soils of the county.

The predicted yields in columns A and B are the average yields that can be expected over a period of several years and are an average of the yields obtained over the last few years, including years that had below-normal yields and years that had above-normal yields. Higher yield can be expected as new crop varieties, insect and disease controls, and farming techniques are introduced.

Management of Soils for Range[3]

About 44 percent of the total acreage in Howard County is rangeland. Areas of range, generally land that is not suitable for cultivation, occur throughout the county. The largest area is in the Valentine-Thurman-Libory and Coly-Holder-Uly soils associations.

The raising of livestock, mainly cow and calf herds, is the largest enterprise in the county.

Range sites and condition classes

Rangeland is classified into range sites according to its capacity to produce native vegetation. Different kinds of range produce different kinds and amounts of vegetation. In order to manage a range properly, an operator needs to know the kinds of soil, or the range site, and the native plants that grow on each site, and accordingly plan management that favors the growth of the best forage plants.

Each range site has its own soils and environmental conditions, and these produce a characteristic plant community (fig. 12). The plant community that uses the site fully and that maintains and reproduces itself is called the climax vegetation for the site.

Climax vegetation, generally the most productive combination of range plants on a site, is the combination of plants that originally grew on the site. This mixture of plants grows on a site so long as the site is not overgrazed and the environment remains unchanged.

Climax vegetation is altered by intensive grazing. Livestock graze selectively and seek the more palatable and nutritious plants. Plants react to grazing in one of three ways. They decrease, increase, or invade.

Native plants are referred to as decreasers, increasers, and invaders. Decreasers and increasers are part of the climax vegetation. *Decreasers* are the most heavily grazed and are the first to be reduced or killed if the site

[3] Prepared by PETER N. JENSEN, range conservationist, Soil Conservation Service.

TABLE 2.—*Predicted average acre yields of principal dryfarmed and irrigated crops under two levels of management*

[Yields in columns A are those expected under average management; yields in columns B indicate yields under improved or high level management. The top yield figure is for dryland yields, and the bottom figure is for irrigated yields. Absence of figure indicates crop is not grown on soil, or that yield data is not available. Only arable soils are listed]

Soil	Alfalfa		Corn		Sorghum		Wheat	
	A	B	A	B	A	B	A	B
	Tons	*Tons*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*
Boel loamy fine sand.	1.7	2.6	23	35	25	37	14	20
	2.8	3.8	65	85	65	85		
Boel fine sandy loam.	1.8	2.7	25	38	27	40	15	22
	3.0	4.0	70	90	70	88		
Boel loam.	1.9	2.8	28	42	30	44	16	23
	3.2	4.2	75	95	72	92		
Coly silt loam, 5 to 11 percent slopes.	1.3	2.3	15	23	22	31	14	20
Darr fine sandy loam.	1.6	2.5	22	32	26	36	16	22
	4.0	5.1	85	110	80	105		
Darr silt loam.	1.8	2.7	24	34	28	38	18	25
	4.2	5.2	90	115	85	110		
Detroit silt loam, 0 to 1 percent slopes.	2.0	3.0	32	42	37	47	24	30
	4.2	5.6	100	135	90	115		
Elsmere loamy fine sand.	1.7	2.6	25	37	27	39	14	20
	3.0	4.0	70	90	70	88		
Geary soils, 7 to 11 percent slopes, severely eroded.	1.1	2.1	14	22	19	28	12	18
Gibbon silt loam.	2.8	3.5	42	55	44	56	20	25
	4.4	5.5	90	110	80	100		
Grigston silt loam.	2.6	3.4	35	45	40	51	22	30
	4.5	6.2	105	150	95	125		
Hall silt loam, 0 to 1 percent slopes.	2.2	3.0	33	43	38	48	24	30
	4.6	6.2	110	145	95	120		
Hastings silt loam, 0 to 1 percent slopes.	1.9	2.7	28	38	36	46	24	30
	4.4	5.8	105	140	95	115		
Hobbs silt loam, 0 to 1 percent slopes.	2.6	3.3	35	47	40	53	22	30
	4.7	6.4	110	150	100	125		
Hobbs silt loam, occasionally flooded.	2.3	3.3	32	48	37	55		
	4.2	6.4	95	130	90	115		
Hobbs silt loam, 1 to 3 percent slopes.	2.2	3.1	33	45	39	51	23	30
	4.5	6.0	105	135	95	115		
Hobbs silt loam, 3 to 5 percent slopes.	1.9	2.8	28	38	36	46	21	28
	4.2	5.8	90	110	85	105		
Holder silt loam, 0 to 1 percent slopes.	2.0	2.8	30	40	38	48	24	30
	4.5	6.0	105	140	95	115		
Holder silt loam, 1 to 3 percent slopes.	1.9	2.7	28	38	36	46	22	28
	4.3	5.8	100	130	90	110		
Holder silt loam, 3 to 5 percent slopes, eroded.	1.8	2.6	24	34	33	43	20	26
	4.0	5.6	90	105	85	100		
Holder silt loam, 5 to 11 percent slopes.	1.6	2.4	22	32	30	40	18	26
Holder silty clay loam, 5 to 11 percent slopes, eroded.	1.6	2.4	20	28	27	37	16	24
Holder silty clay loam, 5 to 11 percent slopes, severely eroded.	1.5	2.4	18	26	26	35	15	22
Hord silt loam, 0 to 1 percent slopes.	2.5	3.2	35	45	40	51	24	30
	4.7	6.4	110	150	100	125		
Inavale loamy fine sand.	1.2	1.7	14	20	17	23	10	16
	2.6	3.6	62	80	62	80		
Inavale fine sandy loam.	1.3	1.8	15	22	18	25	12	18
	2.8	3.8	66	87	66	85		
Inavale loam.	1.4	1.9	16	24	19	28	13	19
	3.0	4.0	70	90	70	88		
Kenesaw silt loam, 0 to 1 percent slopes.	1.8	2.6	26	38	35	45	20	27
	4.2	5.8	100	130	90	115		
Kenesaw silt loam, 1 to 5 percent slopes.	1.6	2.4	24	34	33	43	18	25
	3.9	5.6	90	110	85	105		
Kenesaw silt loam, 5 to 11 percent slopes.	1.5	2.3	20	28	28	38	16	23
Kenesaw-Slickspots complex.	1.4	2.2	15	25	20	31	15	21
	3.5	5.0	80	100	75	95		
Lamo silt loam.	2.8	3.5	45	56	43	54	19	24
	4.4	5.5	85	110	80	95		
Libory-Boelus fine sands.	2.5	3.7	24	36	26	38	12	19
	4.0	5.0	80	100	75	95		

TABLE 2.—*Predicted average acre yields of principal dryfarmed and irrigated crops under two levels of management*—Con.

Soil	Alfalfa		Corn		Sorghum		Wheat	
	A	B	A	B	A	B	A	B
	Tons	*Tons*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*
Libory-Boelus loamy fine sands.	3.0	4.0	34	44	36	46	18	26
	4.5	5.6	95	120	90	110	--------	--------
Loretto complex, 0 to 5 percent slopes.	2.8	3.8	35	45	38	48	20	28
	4.6	5.8	100	125	95	115	--------	--------
O'Neill loam, 0 to 3 percent slopes.	1.0	1.7	18	28	21	31	15	23
	3.6	5.0	80	105	78	100	--------	--------
Ord fine sandy loam.	2.3	3.1	28	43	33	48	19	24
	3.9	4.9	80	100	75	95	--------	--------
Ord loam.	2.4	3.3	30	45	35	50	20	25
	4.0	5.0	85	105	80	100	--------	--------
Ortello loamy fine sand, 1 to 5 percent slopes.	1.4	2.2	23	33	26	36	15	23
	3.4	4.8	75	100	70	95	--------	--------
Ortello fine sandy loam, 0 to 1 percent slopes.	1.5	2.3	25	35	28	38	18	25
	3.8	5.2	85	110	80	105	--------	--------
Ortello loam, 0 to 1 percent slopes.	1.6	2.5	27	37	30	40	20	27
	4.0	5.3	90	115	85	110	--------	--------
Ortello loam, 1 to 5 percent slopes.	1.5	2.3	25	35	28	38	17	25
	3.6	5.0	80	105	75	100	--------	--------
Ovina loamy fine sand.	2.5	3.3	26	40	28	42	14	20
	3.6	5.0	75	95	72	92	--------	--------
Rusco silt loam.	2.0	2.8	24	38	30	45	17	25
	3.8	5.4	95	140	87	110	--------	--------
Silver Creek-Slickspots complex.	1.7	2.5	19	29	23	33	16	22
	3.5	5.2	80	100	75	95	--------	--------
Thurman loamy fine sand, 0 to 3 percent slopes.	1.3	2.1	20	32	23	35	14	22
	3.0	4.0	70	90	70	88	--------	--------
Thurman loamy fine sand, 3 to 5 percent slopes.	1.1	1.9	15	27	18	30	12	20
	2.8	3.8	65	85	65	82	--------	--------
Thurman loamy fine sand, loamy substratum, 0 to 3 percent slopes.	2.5	3.3	25	38	27	39	15	23
	3.8	5.0	80	100	75	95	--------	--------
Uly silt loam, 5 to 11 percent slopes.	1.6	2.4	20	30	28	40	17	25

is overgrazed. *Increasers* are less palatable than decreasers and become more abundant when the decreasers begin to decline. If the increasers are grazed heavily, they decline and are replaced by invaders. *Invaders* are weeds that become established after the climax vegetation has been reduced by heavy, continuous grazing.

Range condition is classified according to the proportion of climax vegetation on the site. It is determined by comparing the kind and number of plants that make up the vegetation with those in the potential native plant cover for the same site. Range condition indicates the degree to which the composition of the existing plant community differs from the potential, or climax, vegetation. Four classes are recognized. A range is in *excellent* condition if 76 to 100 percent of the vegetation is climax; in *good* condition if the percentage is between 51 and 75; in *fair* condition if the percentage is between 26 and 50; and in *poor* condition if the percentage is 25 or lower.

Changes in range condition are related mainly to intensity of grazing and drought. A significant difference in the climax vegetation is one great enough to require some variation in management, for example, a different stocking rate.

Management and improvement practices

Management that maintains or improves the range condition is needed on all rangeland. Among these are proper grazing (fig. 13), deferred grazing, and planned grazing.

The proper distribution of livestock in a pasture can be improved by correctly locating fences, livestock water developments, and salting facilities.

Practices to improve range condition include range seeding. This is the establishment of native grasses by seeding or reseeding, either wild harvest or improved strains, on soil suitable for use as range. Some soils that are being used for crops should be range seeded (fig. 14). Examples of these are Coly silt loam, 11 to 31 percent slopes, and Coly-Uly complex, 15 to 31 percent slopes. The most important grasses used in the seed mixture should include big bluestem, little bluestem, indiangrass, switchgrass, and side-oats grama. No special care other than management of grazing is needed to maintain forage composition.

Native meadows in Howard County are limited to Wet Land and Subirrigated range sites. Soils such as those in the Tryon and Boel series along the Middle Loup River are used extensively for this purpose (fig. 15).

Descriptions of range sites

The range sites in Howard County are Wet Land, Subirrigated, Silty Overflow, Sandy Lowland, Silty Lowland, Saline Lowland, Sandy, Sands, Silty, Limy Upland, Shallow to Gravel, and Thin Loess. All are described in the pages that follow. Included in each

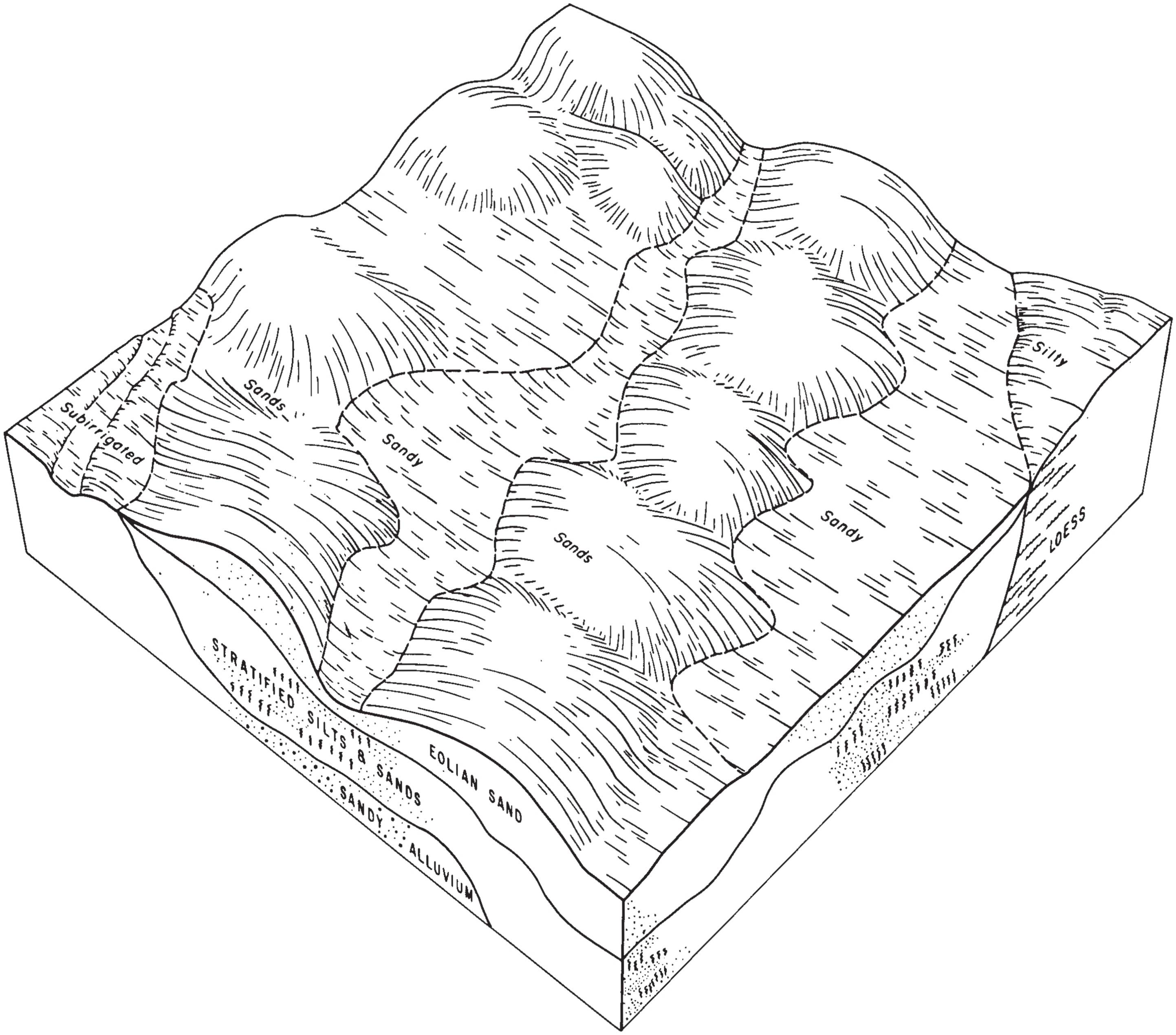

Figure 12.—**Distribution of range sites on sandy soils.**

description is the dominant vegetation when the site is in excellent condition, the dominant vegetation when the site is in poor condition, and the total annual yield in pounds, air-dry weight, for years when rainfall is average and the site is in excellent condition.

The names of the soils represented are mentioned in the description of each range site, but this does not mean that all the soils of a given series are in that site. To find the names of all the soils in any given site, refer to the "Guide to Mapping Units" at the back of this survey.

WET LAND RANGE SITE

This site is on bottom land. The only soil is Tryon loam. It is a deep, nearly level soil underlain by fine sand. The kind of vegetation is influenced by the high water table, which fluctuates within a depth of 3 feet during most of the year and is generally at the surface early in the growing season.

The climax plant cover is a mixture of such decreaser grasses as prairie cordgrass and reedgrass. These make up at least 65 percent of total number of plants; other perennial grasses and forbs account for the rest. Sedge is

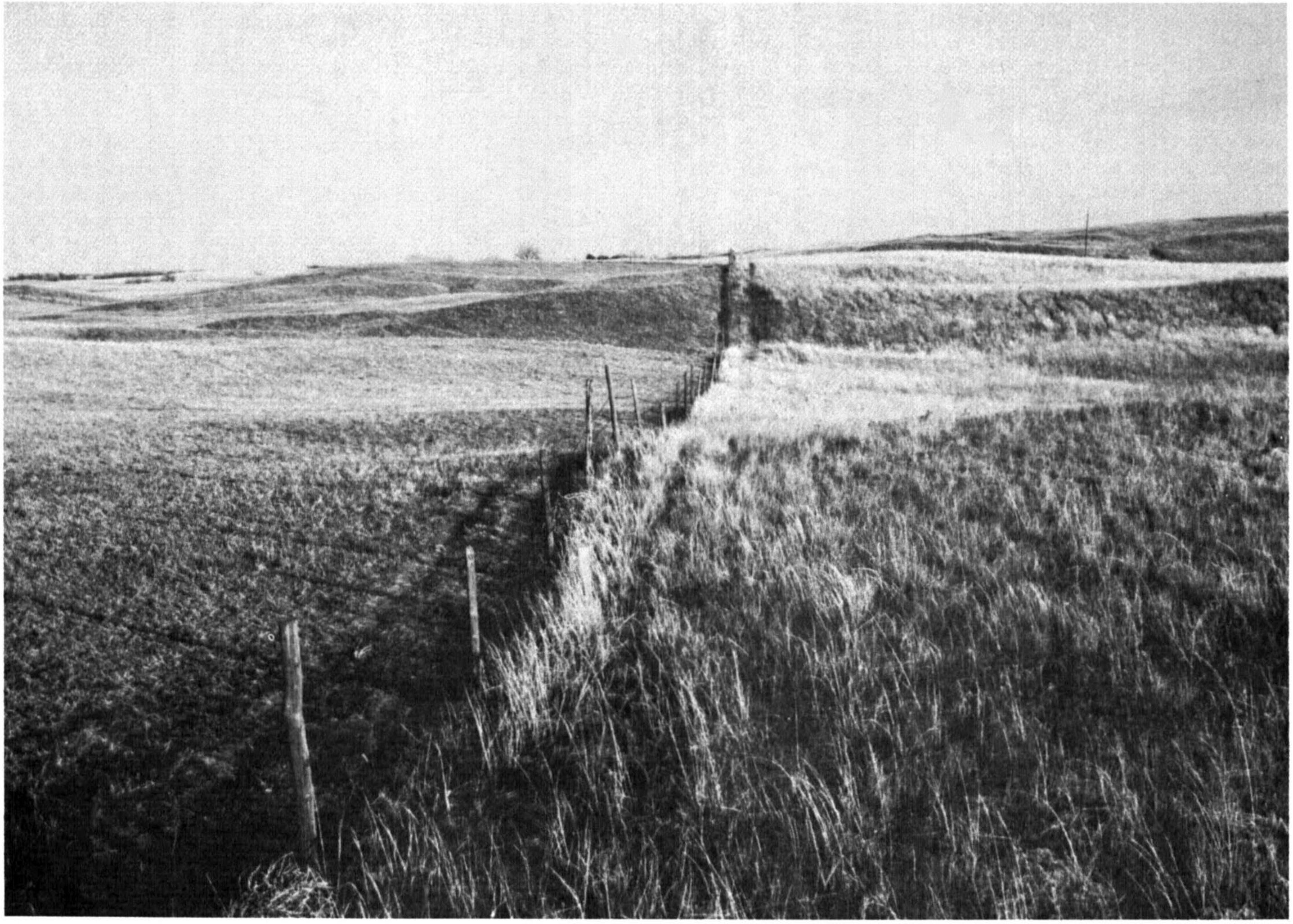

***Figure 13.*—Fence line contrast on Valentine fine sand, rolling.**

the principal increaser. When the site is in poor range condition, the typical plant community consists of Kentucky bluegrass, redtop, willows, and sparse amounts of prairie cordgrass and sedge.

If rainfall is average and the site is in excellent condition, the total annual production of air-dry herbage is 6,000 to 7,000 pounds per acre.

SUBIRRIGATED RANGE SITE

This site is on bottom land and stream terraces. Soils of the Boel, Elsmere, Gibbon, Lamo, Ord, Ovina, Silver Creek, and Tryon series make up the site. They are deep and nearly level. They range from silt loam to loamy fine sand in the surface layer and from silty clay loam to fine sand in the transitional layer and underlying material. The kind of vegetation is influenced by the moderately high water table, which fluctuates between depths of 12 and 60 inches. The water table is rarely at the surface, but it is within the root zone during the growing season.

The climax plant cover is big bluestem, indiangrass, switchgrass, prairie cordgrass, Canada wildrye, and other decreaser grasses mixed with other perennial grasses and forbs. At least 75 percent of the climax vegetation is decreaser grasses. Little bluestem, western wheatgrass, and sedge are the principal increasers. When the site is in poor range condition, the typical plant community consists of Kentucky bluegrass, foxtail barley, redtop, blue verbena, and sparse amounts of western wheatgrass, quackgrass, and sedge. Eastern redcedar is an undesirable invader in some areas that are not mowed.

If rainfall is average and the site is in excellent condition, the total annual production of air-dry herbage is 5,000 to 6,000 pounds per acre.

SILTY OVERFLOW RANGE SITE

This site is on bottom land that is occasionally flooded. It consists of Hobbs silt loam, occasionally flooded, and Silty alluvial land. These deep, nearly level soils have a

Figure 14.—Coly-Uly complex, 15 to 31 percent slopes. These soils are not suitable for cultivation.

silt loam surface layer and silt loam underlying material. The kind of vegetation is influenced by the additional water from periodic overflow or runoff of adjacent areas, the silt deposits, and the high available water capacity and moderate permeability of the soils.

The climax plant cover is big bluestem, indiangrass, switchgrass, Canada wildrye, and other decreaser grasses mixed with other perennial grasses and forbs. The decreasers make up about 70 percent of the climax vegetation. Western wheatgrass, little bluestem, side-oats grama, and sedge are the principal increasers. When the site is in poor condition, the typical plant community consists of Kentucky bluegrass, Baldwin ironweed, western wheatgrass, and blue grama.

If rainfall is average and the site is in excellent condition, the total annual production of air-dry herbage is 4,000 to 5,000 pounds per acre.

SANDY LOWLAND RANGE SITE

This site is on bottom land and stream terraces. The soils are in the Darr and Thurman series. They are deep and moderately deep and nearly level to gently sloping. They have a silt loam to fine sand surface layer and loamy fine sand to coarse sand underlying material. The kind of vegetation is influenced by additional beneficial moisture from a moderately deep water table, which fluctuates between depths of 6 and 10 feet, and from periodic overflow.

The climax plant cover is sand bluestem, indiangrass, switchgrass, little bluestem, needle-and-thread, Canada wildrye, and other decreasers mixed with other perennial grasses and forbs. The decreasers make up at least 75 percent of the climax vegetation. Prairie sandreed, sand dropseed, western wheatgrass, and sedge are the principal increasers. When the site is in poor condition, the

Figure 15.—**Native meadow on Tryon loam.**

typical plant community consists of sand dropseed, blue grama, and western ragweed.

If rainfall is average and the site is in excellent condition, the total annual production of air-dry herbage is 3,000 to 4,000 pounds per acre.

SILTY LOWLAND RANGE SITE

This site is on seldom flooded bottom land and stream terraces. The soils are in the Detroit, Grigston, Hall, Hobbs, Hord, and Rusco series. They are deep and nearly level to gently sloping. Their surface layer is silt loam, and the subsoil and underlying material are silt loam to silty clay. The kind of vegetation is influenced by additional moisture from runoff of adjacent areas, and the high available water capacity and moderate to moderately slow permeability of the soils.

The climax plant cover is big bluestem, indiangrass, little bluestem, switchgrass, needle-and-thread, Canada wildrye, and other decreasers mixed with other perennial grasses and forbs. The decreasers make up at least 75 percent of the potential vegetation. Blue grama, side-oats grama, and western wheatgrass are the principal increasers. When the site is in poor range condition, the typical plant community consists of Kentucky bluegrass, western wheatgrass, blue grama, Baldwin ironweed, and western ragweed.

If rainfall is average and the site is in excellent condition, the total annual production of air-dry herbage is 3,000 to 4,000 pounds per acre.

SALINE LOWLAND RANGE SITE

This site is on stream terraces. It consists of Slickspots. These are deep soils that have a silt loam surface layer and a silty clay loam to silty clay subsoil. Slickspots are saline-alkali. The kind of vegetation is influenced by additional moisture from runoff of adjacent areas or from a moderately deep water table, at a depth of 5 to 8 feet. In addition, the moderately saline or alkali Slickspots inhibit the growth of grasses that do not tolerate salts.

The climax plant cover is switchgrass, indiangrass,

western wheatgrass, Canada wildrye, and other decreaser grasses mixed with other perennial grasses and forbs. At least 65 percent of the potential vegetation is decreaser grasses. Inland saltgrass and sedge are the principal increasers. When the site is in poor range condition, the typical plant community consists of inland saltgrass, Kentucky bluegrass, and annuals.

If rainfall is average and the site is in excellent condition, the total annual production of air-dry herbage is 3,000 to 4,000 pounds per acre.

SANDY RANGE SITE

This site is on stream terraces and uplands. The soils are in the Boelus, Libory, Loretto, O'Neill, Ortello, and Thurman series. They are deep to moderately deep, well drained to somewhat excessively drained, and nearly level to gently sloping. They range from loam to loamy fine sand in the surface layer and from silt loam to coarse sand in the subsoil and underlying material. The kind of vegetation is influenced by the moderately rapid permeability of the soils and the good to somewhat excessive drainage.

The climax plant cover is bluestem, switchgrass, indiangrass, needle-and-thread, and other decreaser grasses mixed with other perennial grasses and forbs. Decreasers make up at least 70 percent of the potential vegetation. Little bluestem, prairie sandreed, blue grama, sand dropseed, and paspalum, and western wheatgrass are the principal increasers. When the site is in poor range condition, the typical plant community consists of blue grama, sand dropseed, sand paspalum, windmillgrass, and tumblegrass.

If rainfall is average and the site is in excellent condition, the total annual production of air-dry herbage is 2,500 to 3,000 pounds per acre.

SANDS RANGE SITE

This site is on bottom land and uplands. It consists of Boelus, Libory, Inavale, and Valentine soils and Blown-out land. The soils are deep and nearly level to steep, and they range from loam to fine sand in the surface layer and from silt loam to fine sand in the subsoil and underlying material. The kind of vegetation is influenced by the deep storage of moisture that is readily available to plants.

The climax plant cover is sand bluestem, switchgrass, indiangrass, sand lovegrass, prairie junegrass, Canada wildrye, and other decreaser grasses mixed with other perennial grasses and forbs. Decreaser grasses make up at least 65 percent of the potential vegetation. Little bluestem, needle-and-thread, prairie sandreed, blue grama, sand dropseed, and sedge are the principal increasers. When the site is in poor range condition, the typical plant community consists of blue grama, sand dropseed, western ragweed, and annuals.

If rainfall is average and the site is in excellent condition, the total annual production of air-dry herbage is 2,500 to 3,000 pounds per acre.

SILTY RANGE SITE

This site is on uplands. It is made up of soils of the Geary, Hastings, Holder, Kenesaw, Nuckolls, and Uly series. The soils are deep, well drained, and nearly level to strongly sloping. They range from silt loam to silty clay loam in the surface layer, subsoil, and underlying material. The kind of vegetation is influenced by the moderate or moderately slow permeability of the soils, the good drainage, and the high available water capacity.

The climax plant cover is big bluestem, little bluestem, indiangrass, switchgrass, and other decreaser grasses mixed with other perennial grasses and forbs. At least 65 percent of the potential vegetation is decreaser grasses. Side-oats grama, blue grama, buffalograss, and western wheatgrass are the principal increasers. When the site is in poor range condition, the typical plant community consists of blue grama, buffalograss, western ragweed, blue verbena, and plains pricklypear.

If rainfall is average and the site is in excellent condition, the total annual production of air-dry herbage is 3,000 to 3,500 pounds per acre.

LIMY UPLAND RANGE SITE

This site is on uplands. It consists of soils of the Coly series. These soils are well drained to excessively drained, are gently sloping to steep, and have a silt loam surface layer and transitional layer, and silt loam underlying material. They are calcareous near the surface. The kind of vegetation is influenced by the moderate permeability and limy condition of the soils.

The climax plant cover is little bluestem, big bluestem, switchgrass, indiangrass, and other decreaser grasses mixed with other perennial grasses and forbs. At least 65 percent of the potential vegetation is decreaser grasses. Side-oats grama, blue grama, and hairy grama are the principal increasers. When the site is in poor range condition, the typical plant community consists of blue grama, western ragweed, blue verbena, and plains pricklypear.

If rainfall is average and the site is in excellent condition, the total annual production of air-dry herbage is 2,000 to 2,500 pounds per acre.

SHALLOW TO GRAVEL RANGE SITE

This site is on stream terraces. The only soil, Simeon loamy sand, 0 to 3 percent slopes, is nearly level to very gently sloping and 10 to 20 inches deep over coarse sand. The kind of vegetation is influenced by the shallowness and very low available water capacity of the soil.

The climax plant cover is big bluestem, sand bluestem, little bluestem, side oats grama, prairie sandreed, and other decreaser grasses mixed with other perennial grasses and forbs. At least 70 percent of the potential vegetation is decreaser grasses. Blue grama, sand dropseed, western wheatgrass, and sedge are the principal increasers. When the site is in poor range condition, the typical plant community consists of blue grama, sand dropseed, broom snakeweed, western ragweed, and plains pricklypear.

If rainfall is average and the site is in excellent condition, the total annual production of air-dry herbage is 1,500 to 2,000 pounds per acre.

THIN LOESS RANGE SITE

This site is on uplands. It is very steep, and there are many catsteps and landslips. Rough broken land, loess, the only mapping unit in this site, is deep and well

drained and has a silt loam surface layer and silt loam underlying material. It is calcareous at or near the surface and in the underlying material. The kind of vegetation is influenced by steep slopes, very rapid runoff, lack of soil development, and a limy soil condition.

The climax plant cover is little bluestem, big bluestem, switchgrass, side-oats grama, plains muhly, and other decreaser grasses mixed with other perennial grasses and forbs. At least 75 percent of the climax vegetation is decreaser grasses. Blue grama, hairy grama, western wheatgrass, and sand dropseed are the principal increasers. When the site is in a poor range condition, the typical plant community consists of blue grama, hairy grama, sand dropseed, broom snakeweed, and various annuals.

If rainfall is average and the site is in excellent condition, the total annual production of air-dry herbage is 2,000 to 2,500 pounds per acre.

Management of Soils for Windbreaks [4]

Most of the trees planted in Howard County are in windbreaks. Natural stands grow mostly on the Ord and Boel soils on bottom land along the Middle and North Loup Rivers and their tributaries. Ash, boxelder, cedar, cottonwood, American elm, hackberry, bur oak, and willow are native to this county. Other tree and shrub plantings for windbreaks were introduced from other areas.

Except for their value in watershed, for wildlife habitat, and for aesthetic purposes, natural stands have only limited economic value. Early settlers planted trees for protection, shade, and fence posts; and throughout the years, landowners continued to plant trees to protect their buildings, livestock, and soil.

The main types of windbreaks planted in this county are farmstead and feedlot windbreaks. If properly designed and located, windbreaks can control drifting snow and shelter the home, farmyard, and feedlot. A good farmstead or feedlot windbreak adds significantly to the value of a farm.

Field windbreaks are effective in helping to control soil blowing on cropland, especially on sandy soils. They usually consist of strips that are one or two rows wide and 20 to 30 rods apart.

Planting of windbreaks

On most soils, preparation for windbreaks can be the same as for ordinary field crops. Even though many of the trees used for windbreaks are native to this county, they generally do not grow naturally on soils where windbreaks are needed. Unless sandy, the soil needs to be prepared far enough in advance so that it will have time to settle. Alfalfa and grass sod can be left fallow in summer at least a year before planting, and crops can be plowed in the fall. Sandy soils can be planted without advance preparation, or a cover crop can be planted. Cover crops protect the soil before and after planting and also protect the young seedlings (fig. 16).

Windbreaks should be carefully planned. Farmstead windbreaks should not be too close or too far from the area to be protected. The number of rows needed for field windbreaks depends on how susceptible the soils are to blowing and how tall the mature trees will be.

Seedlings selected for planting can be obtained from reputable sources and should be the species that grow best on the soil at the planting location. Trees and shrubs suitable for planting in each of the windbreak groups are listed at the end of this section in the descriptions of the windbreak groups.

Proper planting and care of young trees are necessary if the trees are to thrive on the prairie soils of Howard County. Planting early in spring and packing the soil firmly around the roots keep the seedlings from drying out. Rainfall is limited and irregular. Weeds can be controlled by cultivation or by using chemical weed killers so that they do not compete for moisture. Protecting the trees from livestock and fire, and the seedlings from rabbits and mice are essential in management. Additional information on design, planting, and care of windbreaks is available from the Soil Conservation Service and Extension Forester serving the county.

Soils and windbreaks

The kind of soil and the soil-air-moisture relationship greatly influence the growth of trees in this area. Trees normally grow best on a sandy loam soil. Growth is only fair to poor on clayey soils because they absorb and release moisture too slowly. Sandy soils do not store enough water or plant nutrients to be well suited to trees. Deep soils are better suited than shallow soils because more moisture can be stored for use during droughty periods. Hardwoods require deeper soils than conifers. Conifers make their best growth, however, on the better farming soils.

Table 3 shows the expected height, at 20 years of age, of most trees suitable for windbreaks in Howard County. To obtain the data in the table, measurements were made of trees in windbreaks that were about 20 years old. The measurements were taken on soils of the major windbreak groups in this county.

The soils in each windbreak group have similar characteristics that affect tree growth. The names of the soil series and land types that make up a windbreak group are mentioned in the description of each group, but this does not mean that all the soils of a given series appear in that group. To find the windbreak group designation for a particular soil, refer to the "Guide to Mapping Units" at the back of this survey.

Differences among the soils of each group and differences in the manner of cultivation on each windbreak sampled resulted in a variance of growth for each species. The height figure shown in table 3 represents an average for each species on these soils.

Conifers, such as pine and eastern redcedar, at first grow more slowly than hardwoods, but because of their later growth rate, they are generally equal in height to the hardwoods as they mature. They surpass hardwoods in length of life and in overall effectiveness as a windbreak.

Other pines recommended for this area have a growth rate somewhat similar to that of the ponderosa pine. Eastern redcedar generally is the tree best suited to

[4] Prepared by JAMES W. CARR, JR., forester, Soil Conservation Service.

***Figure 16.*—A windbreak, all redcedar, strengthens an older broadleaf belt. The soil is Ortello fine sandy loam, 0 to 1 percent slopes.**

planting. When mature, it is 30 to 40 feet tall on the better soils. Mature pines and hardwoods are normally somewhat taller.

Following is a brief description of each windbreak group. Included is a list of trees and shrubs suitable for windbreak planting on the soils within each group.

SILTY TO CLAYEY WINDBREAK GROUP

This group consists of Rough broken land, loess, and moderately deep to deep, moderately well drained to excessively drained, nearly level to very steep soils of the Coly, Darr, Detroit, Geary, Grigston, Hall, Hastings, Hobbs, Holder, Hord, Kenesaw, Nuckolls, O'Neill, and

TABLE 3.—*Relative vigor and estimated height, by windbreak groups, of specified trees at 20 years of age*

[Very Wet, Moderately Saline or Alkali, and Undersirable windbreak groups are not included because the need for windbreaks on these soils in Howard County is uncommon]

Windbreak group	Eastern redcedar		Ponderosa pine		Green ash		Hackberry		Honeylocust		Cottonwood	
	Relative vigor	Average height	Relative vigor	Average height	Relative vigor	Average height	Relative vigor	Average height	Relative vigor	Average height	Relative vigor	Average height
		Ft.		*Ft.*		*Ft.*		*Ft.*		*Ft.*		*Ft.*
Silty to clayey	Excellent	17	Excellent	21	Good	22	Good	18	Good	22	Unsuited	(1)
Sandy	Excellent	22	Excellent	29	Good	26	Unsuited	(1)	Good	22	Unsuited	(1)
Very Sandy	Excellent	15	Excellent	25	Unsuited	(1)	Unsuited	(1)	Unsuited	(1)	Unsuited	(1)
Moderately Wet	Excellent	17	Unsuited	(1)	(1)	(2)	(1)	(2)	(1)	(2)	Good	58
Shallow	Excellent	15	Excellent	20	Unsuited	(1)	Unsuited	(1)	Unsuited	(1)	Unsuited	(1)

[1] Not applicable.
[2] Insufficient data available.

Uly series. These soils are on bottom land, stream terraces, and uplands. They have a medium-textured to moderately fine textured surface layer. The subsoil and underlying material are moderately fine textured to coarse textured.

All soils of this group are suitable for windbreak plantings. Good survival and growth of adapted species can be expected. Drought and the moisture competition from weeds and grass are the principal hazards. Water erosion is a hazard in sloping areas. The following trees and shrubs are suitable for planting.

Conifers—eastern redcedar, Rocky Mountain juniper, ponderosa pine, Austrian pine, Scotch pine
Medium to tall broadleafs—green ash, hackberry, bur oak, Russian mulberry
Shrubs—cotoneaster, honeysuckle, lilac, chokecherry, American plum

SANDY WINDBREAK GROUP

This group consists of well-drained to excessively drained, nearly level to gently sloping soils of the Boelus, Darr, Inavale, Libory, Loretto, Ortello, and Thurman series. Darr soils are moderately deep. The rest are deep. All are on bottom land, stream terraces, and uplands. The surface layer is moderately coarse textured to coarse textured, and the subsoil and underlying material are medium textured to coarse textured.

These soils are suited to windbreak plantings if sod or other vegetation is established between the tree rows to control soil blowing. Cultivation should generally be restricted to the tree rows. Drought, moisture competition from grass and weeds, and water erosion in some gently sloping areas are hazards. The following trees and shrubs are suitable for planting.

Conifers—eastern redcedar, Rocky Mountain juniper, ponderosa pine, Austrian pine, Scotch pine
Medium to tall broadleafs—green ash, honeylocust, Russian mulberry
Shrubs—honeysuckle, cotoneaster, lilac, skunkbush sumac, American plum

VERY SANDY WINDBREAK GROUP

This group consists of Blown-out land and deep, well-drained to excessively drained, nearly level to strongly sloping soils of the Boelus, Inavale, Libory, Thurman, and Valentine series. These soils are on bottom land, stream terraces, and uplands. Their surface layer is coarse textured, and the subsoil and underlying material are moderately fine textured to coarse textured.

These soils are so loose that trees have to be planted in shallow furrows and not cultivated. Young seedlings can be blown over during high winds and also covered with drifting sand. Eastern redcedar, ponderosa pine, Rocky Mountain juniper, Austrian pine, and Scotch pine are the only trees suitable for planting.

MODERATELY WET WINDBREAK GROUP

This group consists of Silty alluvial land and deep, moderately well drained to somewhat poorly drained, nearly level to very gently sloping Boel, Elsmere, Gibbon, Hobbs, Lamo, Ord, Ovina, Rusco, and Silver Creek soils and the drained Tryon soils. These soils are on bottom land and stream terraces. The surface layer is medium textured to coarse textured, and the subsoil and underlying material are moderately fine textured to coarse textured. Silty alluvial land and Hobbs soils are subject to flooding of short duration. The somewhat poorly drained soils have a water table that fluctuates between depths of 2 and 6 feet.

These soils are well suited to plantings that tolerate occasional wetness. In some years wetness makes it difficult to establish seedlings and to cultivate between rows. The abundant and persistent herbaceous vegetation competes for moisture. The following trees and shrubs are suitable for planting.

Conifers—eastern redcedar, Austrian pine
Tall broadleafs—white willow, golden willow, green ash, honeylocust, hackberry, cottonwood, black walnut
Shrubs—buffaloberry, chokeberry, red-osier dogwood, American plum

VERY WET WINDBREAK GROUP

The only soil in this group is Tryon loam. It is a deep, poorly drained, nearly level to very gently sloping soil on bottom land. The surface layer is medium textured, and the underlying material is coarse textured. The water table fluctuates within a depth of 3 feet most of the year.

Only those trees and shrubs that tolerate wetness are suitable. The following trees and shrubs can be planted.

Low broadleafs—diamond willow
Tall broadleafs—white willow, golden willow, cottonwood
Shrubs—red-osier dogwood, buffaloberry

MODERATELY SALINE OR ALKALI WINDBREAK GROUP

Slickspots, the only mapping unit in this group, is nearly level to very gently sloping and somewhat poorly drained. It is on stream terraces. The surface layer is medium textured, and the subsoil and underlying material are medium textured to moderately fine textured. Slickspots are moderately saline or alkali.

In some years wetness makes it difficult to establish seedlings and to cultivate between the rows. These soils are suited to species that tolerate moderate concentrations of salts or alkali. The following trees and shrubs are suitable.

Conifers—Rocky Mountain juniper, eastern redcedar, ponderosa pine
Tall broadleafs—green ash, honeylocust, cottonwood
Low broadleafs—Russian-olive
Shrubs—Skunkbush sumac, buffaloberry

SHALLOW WINDBREAK GROUP

The only soil in this group, Simeon loamy sand, 0 to 3 percent slopes, is a shallow, excessively drained, nearly level to very gently sloping soil on stream terraces. The surface layer is coarse textured, and the underlying material is coarse sand.

A limited root zone and a very low available water capacity are the main limitations. Lack of moisture is critical during most years.

The only species suitable for planting is eastern redcedar.

UNDESIRABLE WINDBREAK GROUP

Marsh, the only mapping unit in this group, is nearly level and is on bottom land. The soil material is medium textured in the upper part and coarse textured in the lower part. The water table is at the surface most of the year. Marsh is too wet to be suited to trees.

Management of Soils for Wildlife [5]

Wildlife management requires a knowledge of soils and the kind of vegetation they are capable of producing. The kind, amount, and distribution of vegetation largely determine the kind and number of wildlife that can be produced and maintained.

Fertility, other soil characteristics, and topography affect the wildlife capacity of an area. Fertile soils generally support a larger population of wildlife than infertile soils, and waters drained from fertile soils generally produce more fish.

Topography affects wildlife by its influence on how the soils are used. Rough, irregularly shaped areas are poorly suited to livestock and are commonly poorly suited to crops. The undisturbed vegetation in these areas is valuable for wildlife. Vegetation can often be established if these areas are barren.

Permeability and the rate of water infiltration are important soil characteristics in the construction of ponds for fish and in developing and maintaining habitat for waterfowl. Marshy areas are suitable for the development of habitat for aquatic and semiaquatic fowl and some species of furbearing animals.

The soils of Howard County provide suitable habitat for a variety of game and nongame birds and mammals.

Table 4 shows the suitability of each of the soil association for producing various kinds of vegetation that provide the habitat required by some of the more important game species in Howard County. Ratings are based on soil characteristics and the potential of the soil for producing the kind of vegetation needed for wildlife habitat. Table 4 also shows rating of wildlife habitat for kinds of wildlife.

As shown in table 4, the soil association that has the largest wildlife population does not necessarily have the highest potential for producing wildlife. The Hord-Hobbs and Coly-Holder-Uly associations are examples. The more fertile soils in the Hord-Hobbs association have the potential for supporting large populations of wildlife, but they are too intensively cultivated. The wildlife population in the Coly-Holder-Uly association is larger because the soils are less intensively cultivated, and a better distribution of wildlife food and cover is possible.

Although water is scarce for some furbearers in the Hord-Hobbs association, it is adequate for raccoon, coyote, opossum, and others. Squirrels and cottontail rabbits are adequately provided for in wooded areas in the deeper draws. These areas also provide suitable habitat for deer.

The most important fishery in Howard County is located on the Tryon-Elsmere-Gibbon association along the Loup Rivers. This wooded bottom land yields food and

[5] Prepared by R. J. LEMAIRE, biologist, Soil Conservation Service.

TABLE 4.—*Soil associations rated for major kinds of wildlife habitat, and wildlife habitat rated for kinds of game*

	Suitability for Producing—			
	Woody plants	Herbaceous plants	Grain and seed crops	Aquatic habitat
SOIL ASSOCIATIONS:				
1. Holder-Hastings	Well suited	Well suited	Well suited to suited	
2. Coly-Holder-Uly	Poorly suited	Poorly suited	Unsuited	
3. Hord-Hobbs	Well suited	Well suited	Suited	
4. Kenesaw-Ortello-Libory	Suited	Suited	Suited	
5. Valentine-Thurman-Libory	Suited	Poorly suited	Unsuited to suited	
6. Inavale-Boel-Tryon	Well suited [1]	Well suited [1]	Suited [1]	Well suited.[2]
7. Simeon-O'Neill	Poorly suited [3]	Suited [3]	Unsuited [3]	
8. Tryon-Elsmere-Gibbon	Suited	Suited	Unsuited	Suited.
9. Silver Creek-Slickspots	Well suited	Suited	Poorly suited	Suited.

	Wildlife Habitat					
	Woody plants		Herbaceous plants		Grain and seed crops	
	Food	*Cover*	*Food*	*Cover*	*Food*	*Cover*
KINDS OF GAME:						
Pheasant	Low	High	High	High	High	High.
Bobwhite quail	Low	High	High	High	High	Low.
Deer	High	High	Medium [4]	Low	High	Low.
Waterfowl					High [5]	

[1] Unsuited on Tryon soils.
[2] Well suited on Tryon loam.
[3] Well suited on O'Neill loam.
[4] Medium for white-tailed deer; high for mule deer.
[5] For dabbling ducks and geese, principally in spring and fall.

cover for bobwhite quail, pheasants, deer, squirrels, cottontail rabbits, and others. Furbearers, such as mink and muskrat, also inhabit the area. Marshy areas and the river are used by waterfowl, mainly during migrations in spring and fall. The woodland, water, and wildlife resources in the Tryon-Elsmere-Gibbon association also make it well suited to facilities for outdoor recreation.

The Valentine-Thurman-Libory association is important chiefly for wildlife that requires grassland habitat. Production of crops on the better soils yields a food supply of waste grain for some species. Where the soil and topography are such that crops cannot be grown or cattle grazed, the natural vegetation furnishes fair wildlife habitat.

The Coly-Holder-Uly association provides some of the best habitat for pheasants in Howard County. Corn, milo, and wheat crops are excellent sources of food for this species, and the wheat provides nesting areas that are generally undisturbed until after the peak of the pheasant hatch. This association also contains areas of undisturbed native shrubs and grassy and herbaceous vegetation. These areas are important for a variety of wildlife species.

Stream valleys in the county are wooded and provide habitat for quail, squirrel, cottontail rabbits, deer, and a number of other animals. Mourning doves are also common. Ponds for fish can be developed in some wet areas leading to streams. Scattered areas of Marsh are excellent habitat for wildlife requiring this type of cover.

Upland areas in the Coly-Holder-Uly association have numerous sites suitable for ponds and dams. The ponds can be stocked with bass, bluegill, channel catfish and other warmwater fish. The amount of clay held in suspension in most impounded water somewhat limits fish production.

Good production of pheasants is obtained in the Hord-Hobbs association. These highly productive soils are intensively farmed, and they provide many of the requirements for good pheasant populations.

Developing habitat for wildlife requires proper location and distribution of vegetation. Technical assistance in planning wildlife developments and determining the kinds of plantings to be established can be obtained at the work unit office of the Soil Conservation Service in St. Paul, Nebraska. Additional information and assistance can be obtained from the Nebraska Game and Parks Commission, the Bureau of Sport Fisheries and Wildlife, and from the Federal Extension Service.

Engineering Uses of Soils [6]

This section is useful to those who need information about soils used as structural material or as foundation upon which structures are built. Among those who can benefit from this section are planning commissions, town and city managers, land developers, engineers, contractors and farmers.

Properties of soils highly important in engineering are permeability, strength, compaction characteristics, drainage condition, shrink-swell potential, grain size, plasticity, and reaction. Also important are slope, depth to water table, and depth to bedrock. The soils in Howard County are sufficiently deep so that bedrock does not affect their use. These properties affect construction and maintenance of roads, airports, pipelines, foundations for small buildings, irrigation systems, ponds and small dams, and systems for disposal of sewage and refuse.

The data given in this section of the soil survey can help in determining—

1. Possible sites for industrial, commercial, and residential construction and recreation sites.
2. Preliminary routes for highways, underground utilities, and airport locations.
3. Possible sites for drainage systems, farm ponds, irrigation systems, sewage and feed lot runoff disposal systems.
4. Sites for borrow materials for highway embankment and for highway subbase, base, and surface courses.
5. Drainage areas and volumes of surface water runoff for bridge and culvert design.
6. Maintenance of structures and vegetation maintenance.
7. Detailed investigation needed after surface soils are located.
8. Possible corrosion of underground structures.

The engineering interpretations reported in tables 5, 6, and 7 do not eliminate the need for detailed field investigations at the site of specific engineering works. This is particularly important in areas involving heavy loads, and where excavations are deeper than the depths of layers here reported. The estimates generally are to a depth of 5 feet, and interpretations normally do not apply to greater depths.

Small areas of other soils are included in the mapping units. The soil map is useful in planning foundation investigations and indicating the kind of problems that may be expected.

Terms in this soil survey are those used by soil scientists and are defined in the Glossary. Engineering terminology is explained under "Engineering Classification System" and "Engineering Interpretations of the Soils."

Engineering classification systems

Soils are classified so that people can communicate in common terms. Two systems of soil classification used widely for engineering purposes are described below. The relationship between these two classification systems and the USDA Textural Classification is indicated in table 6.

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS (AASHO) SYSTEM.—In this system, seven groups of soils are classified on the basis of field performance (*1*). The groups are classified from A–1, which consists of soils that have the highest bearing capacity, to A–7, which consists of soils that have the lowest strength when wet. A–1, A–2 and A–3 soils are mostly sand and gravel mixtures, while A–4 through A–7 soils are mostly silt and clay mixtures. The probable performance of the soil on the site is indicated by a group index number.

[6] This section was prepared by SYDNEY H. HAAKENSTAD, area engineer, and CHARLES F. MAHNKE, soil scientist, Soil Conservation Service, with the assistance of ROBERT J. FREDRICKSON, civil engineer, Soil Conservation Service, and WILLIAM J. RAMSEY, Division of Materials and Tests, Nebraska Department of Roads.

TABLE 5.—*Engineering*

[Tests performed by the Nebraska Department of Roads in cooperation with U.S. Department of Commerce, Bureau of Public

Soil name and location	Parent material	Report No.	Depth	Moisture density [1]	
				Maximum dry density	Optimum moisture
			In.	*Lb/cu. ft.*	*Pct.*
Coly silt loam: 50 feet south and 0.18 mile east of NW. corner, sec. 14, T. 16 N., R. 10 W. (Modal)	Peoria Loess.	S64-7573	0-4	98	21
		S64-7574	8-72	105	19
Hastings silt loam: 170 feet west and 185 feet north of east quarter corner, sec. 29, T. 16 N., R. 10 W. (Modal)	Peoria Loess.	S64-7575	0-7	102	17
		S64-7576	16-25	95	23
		S64-7577	44-72	104	19
Hobbs silt loam: 0.4 mile west and 100 feet north of SE. corner of sec. 8, T. 14 N., R. 10 W. (Modal)	Colluvium and alluvium.	S64-7578	5-18	101	19
		S64-7579	28-45	104	18
		S64-7580	45-63	99	22
Holder silt loam: 0.25 mile north and 0.45 mile west of SE. corner of sec. 33, T. 14 N., R. 12 W. (Modal)	Peoria Loess.	S64-7581	0-4	105	18
		S64-7582	19-33	96	22
		S64-7583	40-72	101	20
Hord silt loam: 0.15 mile north and 100 feet west of SE. corner of sec. 14, T. 15 N., R. 11 W. (Modal)	Loess and alluvium.	S64-7584	6-20	99	21
		S64-7585	20-33	98	20
		S64-7586	39-60	106	18
Inavale loamy fine sand: 150 feet north and 100 feet west of SE. corner, sec. 22, T. 13 N., R. 11 W. (Modal)	Sandy alluvium.	S64-7589	0-8	116	13
		S64-7590	23-72	105	14
Ord loam: 100 feet east and 0.1 mile north of SW. corner, sec. 27, T. 13 N., R. 11 W. (Modal)	Sandy alluvium.	S64-7599	0-9	95	21
		S64-7600	9-23	107	14
		S64-7601	32-72	103	14
Ortello fine sandy loam: 0.2 mile east and 0.15 mile south of NW. corner, sec. 32, T. 15 N., R. 10 W. (Modal)	Eolian sand.	S64-7570	7-15	114	13
		S64-7571	15-25	113	13
		S64-7572	50-72	103	15
Simeon loamy sand: 140 feet east and 150 feet south of NW. corner of sec. 21, T. 14 N., R. 10 W. (Modal)	Sandy alluvium.	S64-7587	0-8	119	9
		S64-7588	14-72	105	13
Thurman loamy fine sand: 75 feet north and 300 feet west of SE. corner of sec. 5, T. 14 N., R. 9 W. (Modal)	Eolian sand.	S64-7597	0-7	109	12
		S64-7598	14-72	108	11
Uly silt loam: 0.2 mile south and 0.1 mile east of NW. corner of sec. 13, T. 16 W., R. 10 W. (Modal)	Peoria Loess.	S64-7594	0-6	93	23
		S64-7595	6-15	94	21
		S64-7596	19-72	104	19

[1] Based on AASHO Designation: T 99-70, Method A (*1*).
[2] Mechanical analysis according to AASHO Designation: T 88-70 (*1*). Results differ somewhat from results obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHO procedure, the fine material is analyzed by the hydrometer method, and the various grain-size fractions are calculated on the basis of all the material, including that coarser than 2 millimeters in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method and the material coarser than 2 millimeters in diam-

test data

Roads (BPR), in accordance with standard procedures of the American Association of State Highway Officials (AASHO) (*1*)]

Mechanical analysis [2]								Liquid limit	Plasticity index	Classification	
Percentage passing sieve				Percentage smaller than—						AASHO	Unified [3]
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	0.05 mm.	0.02 mm.	0.005 mm.	0.002 mm.				
								Pct.			
---------	----------	100	98	90	42	24	18	40	17	A-6(11)	CL
---------	----------	100	99	91	44	21	14	37	14	A-6(10)	ML-CL
---------	----------	100	98	88	43	27	21	29	8	A-4(8)	ML-CL
---------	----------	100	99	93	60	44	38	49	25	A-7-6(16)	CL
---------	----------	100	99	91	44	21	14	34	11	A-6(8)	ML-CL
---------	----------	100	99	91	42	25	22	35	13	A-6(9)	ML-CL
---------	----------	100	98	89	41	23	18	34	10	A-4(8)	ML-CL
---------	----------	100	95	86	49	25	18	39	16	A-6(10)	CL
---------	----------	100	98	85	40	25	17	35	12	A-6(9)	ML-CL
---------	----------	100	99	92	63	36	29	42	20	A-7-6(12)	CL
---------	----------	100	99	98	45	19	13	34	11	A-6(8)	ML-CL
---------	----------	100	95	83	43	25	17	35	12	A-6(9)	ML-CL
---------	----------	100	97	88	56	36	29	42	20	A-7-6(12)	CL
---------	----------	100	99	79	35	19	13	34	11	A-6(8)	ML-CL
---------	100	95	35	21	11	6	5	[4] NP	NP	A-2-4(0)	SM
---------	100	96	6	3	2	1	1	NP	NP	A-3(0)	SP-SM
---------	----------	100	73	51	23	9	5	36	8	A-4(8)	ML
---------	----------	100	65	33	12	6	5	NP	NP	A-4(6)	ML
---------	100	99	9	4	2	1	1	NP	NP	A-3(0)	SP-SM
---------	----------	100	46	32	20	12	12	22	4	A-4(2)	SM
---------	----------	100	23	16	11	9	9	NP	NP	A-2-4(0)	SM
---------	----------	100	22	9	5	5	4	NP	NP	A-2-4(0)	SM
100	98	74	14	10	7	3	2	NP	NP	A-2-4(0)	SM
---------	100	71	1	1	1	0	0	NP	NP	A-3(0)	SP
---------	100	99	23	14	7	4	4	NP	NP	A-2-4(0)	SM
---------	----------	100	16	8	7	5	4	NP	NP	A-2-4(0)	SM
---------	----------	100	98	88	42	24	18	45	15	A-7-5(11)	ML
---------	----------	100	99	90	51	32	28	43	18	A-7-6(12)	ML-CL
---------	----------	100	99	87	43	21	14	34	12	A-6(9)	ML-CL

eter is excluded from calculations of grain-size fractions. The mechanical analysis data used in this table are not suitable for naming textural classes for soils.

[3] SCS and BPR have agreed to consider that all soils having plasticity indexes within two points of the A-line are to be given a borderline classification. An example of a borderline classification obtained by this use is ML-CL.

[4] Nonplastic.

TABLE 6.—*Estimates of soil properties*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. The soils for referring to other series that appear

Soil series and map symbols	Depth to— Sand or gravel	Depth to— Seasonal high water table	Depth from surface	Classification USDA texture	Classification Unified [1]	Classification AASHO [1]
	Ft.	*Ft.*	*In.*			
Blown-out land: B	0–1	(2)	0–60	Fine sand	SM or SP–SM	A–2 or A–3
Boel: [3]						
Boa	1–2	2–6	0–11	Loamy fine sand	SM	A–2
			11–60	Fine sand	SM, SP–SM or SP	A–2 or A–3
Bob	1–2	2–6	0–11	Fine sandy loam	SM or ML	A–4
			11–60	Fine sand	SM, SP–SM or SP	A–2 or A–3
Boc	1–2	2–6	0–11	Loam	ML	A–4
			11–60	Fine sand	SM, SP–SM or SP	A–2 or A–3
Boelus. Mapped only with Libory soils.	(4)	(2)	0–19	Loamy fine sand	SM	A–2
			19–60	Silt loam	ML or CL	A–4 or A–6
*Coly: CbC, CbD, CUD. For Uly part of CUD, see Uly series.	(4)	(2)	0–60	Silt loam	ML or CL	A–6
Darr:						
Da	2–3	6–10	0–12	Fine sandy loam	SM or ML	A–4
			12–26	Sandy loam	SM or ML	A–4
			26–60	Coarse sand	SP–SM, SM or SP	A–2 or A–3
Db	2–3	6–10	0–12	Silt loam	ML	A–4 or A–6
			12–26	Sandy loam	SM or ML	A–4
			26–60	Coarse sand	SP–SM, SM or SP	A–2 or A–3
Detroit: De [3]	(4)	(2)	0–5	Silt loam	ML or CL	A–6 or A–7
			5–12	Silty clay loam	ML or CL	A–6 or A–7
			12–31	Silty clay	CH	A–7
			31–52	Silty clay loam	CL or ML	A–7 or A–6
Elsmere: Ea [3]	1½–2	2–6	0–11	Loamy fine sand	SM	A–2
			11–17	Loamy sand	SM	A–2
			17–60	Fine sand and sand	SM, SP–SM or SP	A–2 or A–3
Geary: GsC3, GsD3	(4)	(2)	0–17	Silty clay loam	CL or CH	A–6 or A–7
			17–60	Silt loam	CL or ML	A–6 or A–7
Gibbon: Gg [3]	5–10	2–6	0–40	Silt loam	CL or ML	A–6 or A–4
			40–43	Silty clay loam	ML or CL	A–4 or A–6
			43–60	Very fine sandy loam	ML or CL	A–4 or A–6
Grigston: Gk	6–10	6–10	0–10	Silt loam	CL or ML	A–6 or A–4
			10–19	Light silty clay loam	CL or ML	A–6 or A–4
			19–60	Silt loam	ML or CL	A–4 or A–6
Hall: Ha	(4)	(2)	0–6	Silt loam	ML or CL	A–4 or A–6
			6–14	Light silty clay loam	ML or CL	A–6 or A–7
			14–45	Silty clay loam	CL or CH	A–6 or A–7
			45–60	Silt loam	ML or CL	A–6
Hastings: Hs	(4)	(2)	0–10	Silt loam	ML or CL	A–4 or A–6
			10–25	Silty clay loam	CL or CH	A–6 or A–7
			25–60	Silt loam	CL or ML	A–6
Hobbs: Hb, 2Hb, HbA, HbB	(4)	(2)	0–5	Silt loam	ML or CL	A–4 or A–6
			5–11	Light silty clay loam	ML or CL	A–6 or A–7
			11–60	Silt loam	CL	A–6

See footnotes at end of table.

significant in engineering

in such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instructions in the first column of this table]

Percentage less than 3 inches passing sieve—				Material finer than 0.002 mm.	Permeability	Available water capacity	Shrink-swell potential
No. 4	No. 10	No. 40	No. 200				
				Pct.	*In./hr.*	*In./in. of soil*	
100	95–100	90–95	5–20	2–10	6. 3–20. 0	0. 03–0. 05	Very low.
-----------	100	90–95	15–35	3–15	6. 3–20. 0	0. 10–0. 12	Very low.
100	95–100	90–95	3–15	2–10	6. 3–20. 0	0. 06–0. 08	Very low.
-----------	100	90–100	36–65	7–12	2. 0–6. 3	0. 16–0. 18	Low.
100	95–100	90–95	3–15	2–10	6. 3–20. 0	0. 06–0. 08	Very low.
-----------	100	95–100	51–80	7–12	0. 63–2. 0	0. 20–0. 22	Low.
100	95–100	90–95	3–15	2–10	6. 3–20. 0	0. 06–0. 08	Very low.
-----------	100	90–95	15–35	3–12	6. 3–20. 0	0. 10–0. 12	Very low.
-----------	100	95–100	85–100	12–20	0. 63–2. 0	0. 20–0. 22	Moderate.
-----------	-----------	100	95–100	14–27	0. 63–2. 0	0. 20–0. 22	Moderate.
-----------	100	95–100	40–65	7–15	2. 0–6. 3	0. 16–0. 18	Low.
-----------	100	95–100	36–65	7–15	2. 0–6. 3	0. 12–0. 14	Low.
100	95–100	70–75	3–15	0–5	6. 3–20. 0	0. 03–0. 05	None.
-----------	-----------	100	65–90	12–17	0. 63–2. 0	0. 22–0. 24	Moderate.
-----------	100	95–100	36–65	7–15	2. 0–6. 3	0. 12–0. 14	Low.
100	95–100	70–75	3–15	0–5	6. 3–20. 0	0. 03–0. 05	None.
-----------	-----------	100	90–100	12–27	0. 63–2. 0	0. 22–0. 24	Moderate.
-----------	-----------	100	95–100	27–40	0. 20–0. 63	0. 18–0. 20	Moderate to high.
-----------	-----------	100	95–100	40–60	0. 06–0. 2	0. 11–0. 13	High.
-----------	-----------	100	90–100	27–40	0. 20–0. 63	0. 18–0. 20	Moderate to high.
-----------	100	95–100	15–35	3–10	6. 3–20. 0	0. 10–0. 12	Low.
-----------	100	95–100	15–35	3–10	6. 3–20. 0	0. 09–0. 11	Low.
100	95–100	90–95	3–20	2–10	6. 3–20. 0	0. 06–0. 08	None.
-----------	-----------	100	95–100	27–40	0. 20–0. 63	0. 21–0. 23	Moderate to high.
-----------	-----------	100	95–100	12–27	0. 63–2. 0	0. 20–0. 22	Moderate.
-----------	-----------	100	65–100	12–27	0. 63–2. 0	0. 22–0. 24	Moderate.
-----------	-----------	100	80–100	27–40	0. 20–0. 63	0. 18–0. 20	Moderate to high.
-----------	100	95–100	65–100	12–20	0. 63–2. 0	0. 17–0. 19	Low to moderate.
-----------	-----------	100	65–100	12–27	0. 63–2. 0	0. 22–0. 24	Moderate.
-----------	-----------	100	90–100	28–32	0. 63–2. 0	0. 18–0. 20	Moderate to high.
-----------	-----------	100	90–100	18–27	0. 63–2. 0	0. 20–0. 22	Moderate.
-----------	-----------	100	90–100	18–27	0. 63–2. 0	0. 22–0. 24	Moderate.
-----------	-----------	100	90–100	27–35	0. 20–0. 63	0. 18–0. 20	Moderate.
-----------	-----------	100	90–100	27–35	0. 20–0. 63	0. 18–0. 20	Moderate to high.
-----------	-----------	100	90–100	18–27	0. 63–2. 0	0. 20–0. 22	Moderate.
-----------	-----------	100	95–100	18–27	0. 63–2. 0	0. 22–0. 24	Moderate.
-----------	-----------	100	95–100	35–40	0. 20–0. 63	0. 18–0. 20	Moderate to high.
-----------	-----------	100	95–100	14–27	0. 63–2. 0	0. 20–0. 22	Moderate.
-----------	-----------	100	90–100	18–27	0. 63–2. 0	0. 22–0. 24	Moderate.
-----------	-----------	100	90–100	18–35	0. 63–2. 0	0. 18–0. 20	Moderate to high.
-----------	-----------	100	90–100	15–27	0. 63–2. 0	0. 20–0. 22	Moderate.

TABLE 6.—*Estimates of soil properties*

Soil series and map symbols	Depth to— Sand or gravel	Depth to— Seasonal high water table	Depth from surface	Classification: USDA texture	Classification: Unified [1]	Classification: AASHO [1]
	Ft.	*Ft.*	*In.*			
Holder:						
Hg, HgA, HgB2, HgC	(4)	(2)	0–13	Silt loam	ML or CL	A–4
			13–39	Silty clay loam	CL	A–6 or A–7
			39–60	Silt loam	ML or CL	A–4 or A–6
HpC2, HpC3	(4)	(2)	0–24	Silty clay loam	CL or CH	A–6 or A–7
			24–60	Silt loam	ML or CL	A–4 or A–6
Hord: Hd	(4)	(2)	0–20	Silt loam	ML or CL	A–4 or A–6
			20–30	Light silty clay	CL	A–6 or A–7
			30–60	Silt loam	ML or CL	A–4 or A–6
Inavale:						
If	1–2	6–10	0–13	Fine sand	SM or SP–SM	A–2 or A–3
			13–60	Fine sand	SP–SM, SM or SP	A–2 or A–3
Ig	1–2	6–10	0–13	Loamy fine sand	SM	A–2
			13–60	Fine sand	SP–SM, SM, or SP	A–2 or A–3
In	1–2	6–10	0–13	Fine sandy loam	SM or ML	A–4 or A–2
			13–60	Fine sand	SP–SM, SM or SP	A–2 or A–3
Ia	1–2	6–10	0–10	Loam	ML	A–4
			10–60	Fine sand	SP–SM, SM or SP	A–2 or A–3
Kenesaw: Ks, KsB, KsC, KSz	4–10	(2)	0–46	Silt loam	ML or CL	A–4 or A–6
No valid estimates can be made for Slickspots part of KSz.			46–60	Fine sand	SM or SP–SM	A–2 or A–3
Lamo: La	5–10	2–6	0–13	Silt loam	ML or CL	A–6 or A–7
			13–35	Silty clay loam	CL or CH	A–7
			35–60	Silty clay loam	CL	A–6 or A–7
*Libory:						
LB	5–10	(2)	0–15	Fine sand	SM or SP–SM	A–2 or A–3
For Boelus part of LB, see Boelus series.			15–35	Silt loam	ML or CL	A–6 or A–7
			35–60	Silty clay loam	ML or CL	A–6 or A–7
LC	5–10	(2)	0–10	Loamy fine sand	SM	A–2
For Boelus part of LC, see Boelus series.			10–15	Loamy sand	SM	A–2
			15–35	Silt loam	ML or CL	A–6 or A–7
			35–60	Silty clay loam	ML or CL	A–6 or A–7
Loretto: L	5–10	(2)	0–7	Loamy fine sand	SM	A–2
			7–18	Fine sandy loam	ML or SM	A–2 or A–4
			18–60	Silt loam	ML to CL	A–6 or A–7
Marsh: M. No valid estimates can be made.						
Nuckolls: NsD3	(4)	(2)	0–7	Silt loam	ML or CL	A–6 or A–7
			7–39	Silty clay loam	CL	A–6 or A–7
			39–60	Silt loam	ML or CL	A–6 or A–7
O'Neill: Ok	2–3	(2)	0–14	Loam	ML	A–4
			14–20	Fine sandy loam	SM or ML	A–4 or A–2
			20–26	Loamy sand	SM	A–2
			26–60	Fine sand	SP, SP–SM or SM.	A–3 or A–2

See footnotes at end of table.

significant in engineering—Continued

Percentage less than 3 inches passing sieve—				Material finer than 0.002 mm.	Permeability	Available water capacity	Shrink-swell potential
No. 4	No. 10	No. 40	No. 200				
				Pct.	*In./hr.*	*In./in. of soil*	
		100	95–100	18–27	0. 63–2. 0	0. 22–0. 24	Moderate.
		100	95–100	28–35	0. 20–0. 63	0. 18–0. 20	Moderate to high.
		100	95–100	14–27	0. 63–2. 0	0. 20–0. 22	Moderate.
		100	95–100	28–40	0. 20–0. 63	0. 21–0. 23	Moderate to high.
		100	90–100	14–27	0. 63–2. 0	0. 20–0. 22	Moderate.
		100	90–100	15–27	0. 63–2. 0	0. 22–0. 24	Moderate.
		100	95–100	25–32	0. 63–2. 0	0. 20–0. 22	Moderate to high.
		100	90–100	10–22	0. 63–2. 0	0. 20–0. 22	Moderate.
	100	95–100	8–20	2–10	6. 3–20. 0	0. 07–0. 09	None.
100	95–100	90–95	3–15	0–10	6. 3–20. 0	0. 05–0. 07	None.
	100	95–100	15–35	3–10	6. 3–20. 0	0. 10–0. 12	Low.
100	95–100	90–95	3–15	0–10	6. 3–20. 0	0. 05–0. 07	None.
		100	40–65	7–12	2. 0–6. 3	0. 16–0. 18	Low.
100	95–100	90–95	3–15	0–10	6. 3–20. 0	0. 05–0. 07	None.
		100	55–90	7–12	0. 63–2. 0	0. 20–0. 22	Low.
100	95–100	90–95	3–15	0–10	6. 3–20. 0	0. 05–0. 07	None.
		100	60–90	12–27	0. 63–2. 0	0. 22–0. 24	Moderate.
100	95–100	95–100	3–20	3–10	6. 3–20. 0	0. 05–0. 07	None.
		100	90–100	18–27	0. 63–2. 0	0. 22–0. 24	Moderate.
		100	95–100	28–40	0. 20–0. 63	0. 18–0. 20	Moderate to high.
		100	95–100	28–35	0. 20–0. 63	0. 20–0. 22	Moderate to high.
	100	90–100	9–25	3–10	6. 3–20. 0	0. 07–0. 09	Low.
		100	85–100	18–27	0. 63–2. 0	0. 20–0. 22	Moderate.
		100	90–100	28–35	0. 20–0. 63	0. 18–0. 20	Moderate to high.
	100	90–100	15–35	3–10	6. 3–20. 0	0. 10–0. 12	Low.
	100	90–100	20–35	3–10	6. 3–20. 0	0. 09–0. 11	Low.
		100	85–100	18–27	0. 63–2. 0	0. 20–0. 22	Moderate.
		100	90–100	28–35	0. 20–0. 63	0. 18–0. 20	Moderate to high.
	100	95–100	20–35	5–10	6. 3–20. 0	0. 10–0. 12	Low.
	100	95–100	20–60	7–20	2. 00–6. 30	0. 16–0. 18	Low.
		100	85–100	14–27	0. 63–2. 0	0. 20–0. 22	Moderate.
		100	90–100	18–27	0. 63–2. 0	0. 20–0. 22	Moderate.
		100	90–100	28–40	0. 20–0. 63	0. 18–0. 20	Moderate to high.
		100	90–100	14–27	0. 63–2. 0	0. 20–0. 22	Moderate.
	100	90–100	51–90	7–15	0. 63–2. 0	0. 20–0. 22	Low.
	100	90–100	36–65	5–10	2. 0–6. 3	0. 15–0. 17	Low.
	100	90–100	20–35	2–10	6. 3–20. 0	0. 08–0. 10	Low.
100	85–100	70–80	0–15	0–5	6. 3–20. 0	0. 02–0. 04	None.

TABLE 6.—*Estimates of soil properties*

Soil series and map symbols	Depth to— Sand or gravel	Depth to— Seasonal high water table	Depth from surface	Classification: USDA texture	Classification: Unified [1]	Classification: AASHO [1]
	Ft.	*Ft.*	*In.*			
Ord: [3]						
Of	2-3	2-6	0-14	Fine sandy loam	SM or ML	A-4
			14-26	Sandy loam	SM or ML	A-4
			26-60	Fine sand	SP-SM, SM or SP	A-2 or A-3
Oe	2-3	2-6	0-14	Loam	ML	A-4
			14-26	Sandy loam	SM or ML	A-4
			26-60	Fine sand	SP-SM, SM or SP	A-2 or A-3
*Ortello:						
ObB	3-10	(2)	0-7	Loamy fine sand	SM	A-2
			7-25	Fine sandy loam	SM	A-2 or A-4
			25-42	Loamy fine sand	SM	A-2
			42-50	Fine sandy loam	SM	A-2 or A-4
			50-60	Fine sand	SM or SP-SM	A-2
OrA, OxD. For Coly part of OxD, see Coly series.	3-10	(2)	0-25	Fine sandy loam	SM	A-2 or A-4
			25-42	Loamy fine sand	SM	A-2
			42-50	Fine sandy loam	SM	A-2 or A-4
			50-60	Fine sand	SM or SP-SM	A-2
Ot, OtB	3-10	(2)	0-15	Loam	ML or SM	A-4 or A-6
			15-25	Fine sandy loam	SM	A-2 or A-4
			25-42	Loamy fine sand	SM	A-2
			42-50	Fine sandy loam	SM	A-2 or A-4
			50-60	Fine sand	SM or SP-SM	A-2
Ovina: Oa [3]	5-8	2-6	0-11	Loamy fine sand	SM	A-2
			11-30	Fine sandy loam	SM or ML	A-2 or A-4
			30-40	Loam	ML or CL	A-4 or A-6
			40-60	Fine sandy loam	SM or ML	A-2 or A-4
Rough broken land, loess: RB. [3, 4] No valid estimates can be made.						
Rusco: Ru [3]	5-10	(2)	0-7	Silt loam	ML or CL	A-4 or A-6
			7-26	Silty clay loam	CL or CH	A-6 or A-7
			26-60	Silt loam	ML or CL	A-4 or A-6
Silty alluvial land: Sy [3]. No valid estimates can be made.	(4)	(2)				
Silver Creek: SS [3]. Mapped only with Slickspots.	5-12	5-8	0-8	Silt loam	ML or CL	A-4 or A-6
			8-28	Heavy silty clay loam	CL or CH	A-6 or A-7
			28-60	Silt loam	ML or CL	A-4 or A-6
Simeon: Sm	0-2	(2)	0-8	Loamy sand	SM or SP-SM	A-2 or A-3
			8-60	Medium and coarse sand	SP or SP-SM	A-2 or A-3
Slickspots. No valid estimates can be made. Mapped only with Kenesaw and Silver Creek soils.						
Thurman:						
TfB	0-1	6-10	0-14	Fine sand	SM or SP-SM	A-2 or A-3
			14-60	Fine sand	SM or SP-SM	A-2 or A-3
ThA, ThB	1-4	(2)	0-14	Loamy fine sand	SM	A-2
			14-60	Fine sand	SM or SP-SM	A-2 or A-3
2ThA	(4)	(2)	0-14	Loamy fine sand	SM	A-2
			14-40	Fine sand	SM or SP-SM	A-2 or A-3
			40-60	Silt loam	ML or CL	A-6 or A-7

See footnotes at end of table.

significant in engineering—Continued

Percentage less than 3 inches passing sieve—				Material finer than 0.002 mm.	Permeability	Available water capacity	Shrink-swell potential
No. 4	No. 10	No. 40	No. 200				
				Pct.	*In./hr.*	*In./in. of soil*	
----------	----------	100	40–65	7–12	2. 0–6. 3	0. 16–0. 18	Low.
----------	100	95–100	36–65	7–12	2. 0–6. 3	0. 12–0. 14	Low.
100	95–100	90–95	3–15	0–10	6. 3–20. 0	0. 05–0. 07	None.
----------	----------	100	65–90	7–12	0. 63–2. 0	0. 20–0. 22	Low.
----------	100	95–100	36–75	4–12	2. 0–6. 3	0. 12–0. 14	Low.
100	95–100	90–95	3–15	0–10	6. 3–20. 0	0. 05–0. 07	None.
----------	100	95–100	15–35	3–12	6. 3–20. 0	0. 10–0. 12	Low.
----------	100	95–100	30–50	7–20	2. 0–6. 3	0. 12–0. 14	Low.
----------	100	95–100	15–35	3–10	6. 3–20. 0	0. 09–0. 11	Low.
----------	100	95–100	30–50	7–20	2. 0–6. 3	0. 11–0. 13	Low.
----------	100	95–100	8–35	2–10	6. 3–20. 0	0. 05–0. 07	Low.
----------	100	95–100	30–50	7–20	2. 0–6. 3	0. 16–0. 18	Low.
----------	100	95–100	15–35	5–12	6. 3–20. 0	0. 09–0. 11	Low.
----------	100	95–100	30–50	7–12	2. 0–6. 3	0. 11–0. 13	Low.
----------	100	95–100	8–35	2–10	6. 3–20. 0	0. 05–0. 07	None.
----------	100	100	45–90	7–15	0. 63–2. 0	0. 20–0. 22	Low to moderate.
----------	100	95–100	30–50	7–20	2. 0–6. 3	0. 15–0. 17	Low.
----------	100	95–100	15–35	5–12	6. 3–20. 0	0. 09–0. 11	Low.
----------	100	95–100	30–50	7–12	2. 0–6. 3	0. 11–0. 13	Low.
----------	100	95–100	8–35	2–10	6. 3–20. 0	0. 05–0. 07	Very low.
----------	100	90–100	15–35	5–12	6. 3–20. 0	0. 10–0. 12	Low.
----------	100	95–100	30–60	7–20	2. 0–6. 3	0. 15–0. 17	Low.
----------	----------	100	60–90	7–27	0. 63–2. 0	0. 17–0. 19	Low to moderate.
----------	100	95–100	30–60	7–20	2. 0–6. 3	0. 14–0. 16	Low.
----------	----------	100	90–100	18–27	0. 63–2. 0	0. 22–0. 24	Moderate.
----------	----------	100	95–100	28–35	0. 20–0. 63	0. 18–0. 20	Moderate to high.
----------	----------	100	90–100	18–27	0. 63–2. 0	0. 20–0. 22	Moderate.
----------	----------	100	90–100	18–27	0. 63–2. 0	0. 22–0. 24	Moderate.
----------	----------	100	95–100	35–45	0. 20–0. 63	0. 11–0. 13	Moderate to high.
----------	----------	100	90–100	18–27	0. 63–2. 0	0. 18–0. 20	Moderate.
100	85–100	70–85	5–20	3–10	6. 3–20. 0	0. 10–0. 12	Very low.
100	85–100	60–80	0–5	0–5	7. 0–20. 0	0. 03–0. 05	Very low.
----------	100	95–100	5–25	3–10	6. 3–20. 0	0. 07–0. 09	Very low.
----------	100	90–100	5–20	3–10	6. 3–20. 0	0. 06–0. 08	Very low.
----------	100	95–100	15–35	3–10	6. 3–20. 0	0. 10–0. 12	Low.
----------	100	90–100	5–30	3–10	6. 3–20. 0	0. 05–0. 07	Low.
----------	100	95–100	15–35	3–10	6. 3–20. 0	0. 10–0. 12	Low.
----------	100	90–100	5–35	3–10	6. 3–20. 0	0. 05–0. 07	Low.
----------	----------	100	90–100	18–27	0. 63–2. 0	0. 20–0. 22	Moderate.

TABLE 6.—*Estimates of soil properties*

Soil series and map symbols	Depth to—		Depth from surface	Classification		
	Sand or gravel	Seasonal high water table		USDA texture	Unified [1]	AASHO [1]
	Ft.	*Ft.*	*In.*			
Tryon: Ty, 2To	0. 5–1. 0	0–3	0–5 5–10 10–60	Loam Fine sandy loam Fine sand	ML or ML–CL SM or ML SP–SM, SM or SP	A–4 A–2 or A–4 A–2 or A–3
Uly: UsC, UsD	(4)	(2)	0–8 8–13 13–60	Silt loam Light silty clay loam Silt loam	ML or CL ML or CL CL	A–6 or A–7 A–6 or A–7 A–6
*Valentine: VaC, VTD For Thurman part of VTD, see Thurman series.	0–1	(2)	0–60	Fine sand	SM or SP–SM	A–2 or A–3

[1] If two or more classifications are shown, the classification listed first is considered to be the most common.
[2] Water table is at too great a depth to be significant in engineering.

TABLE 7.—*Engineering*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. The instructions for referring to other series

Soil series and map symbols	Suitability as source of—				Soil features affecting—			
	Topsoil	Sand or mixed sand and gravel	Road subgrade		Road fill	Highway location	Foundations	Dikes and levees
			Paved roads	Gravel roads				
Blown-out land: B	Poor: low fertility; loose.	Good for fine sand below a depth of 1 foot.	Good	Poor	Good: slopes erodible; vibratory compaction equipment required.	Embankments highly erodible; protective cover and numerous cuts and fills required.	Good to fair bearing capacity, depending on density; must be confined.	(2)
Boel: Boa, Bob, Boc	Fair	Good for sand below a depth of 1½ feet.	Good	Poor	Good to fair: water table at a depth of 2 to 6 feet; slopes erodible vibratory compaction equipment required.	Moderate to low susceptibility to frost heave; water table or occasional flooding requires 4- to 7-foot fills; erodible if exposed on embankments.	Good bearing capacity if confined; in places subject to seepage; water table at a depth of 2 to 6 feet.	Slopes erodible; subject to seepage.
Boelus Mapped only with Libory soils.	Fair; depends on percent silt and clay in surface layer.	(1)	Fair to poor.	Good	Good	Susceptible to moderate frost heave; erodible slopes; foundation consolidation requires checking.	Fair depending on density.	Slopes erodible
*Coly: CbC, CbD, CUD For Uly part of CUD, see Uly series.	Poor: low fertility; thin surface layer.	(1)	Fair to poor.	Good to fair.	Fair: slopes moderately erodible; good compaction characteristics.	Susceptibility to frost heave; slopes moderately erodible; high cuts and fills required due to topography.	Fair to good bearing capacity if maintained in dry condition.	(2)

See footnotes at end of table.

significant in engineering—Continued

Percentage less than 3 inches passing sieve—				Material finer than 0.002 mm.	Permeability	Available water capacity	Shrink-swell potential
No. 4	No. 10	No. 40	No. 200				
				Pct.	*In./hr.*	*In./in. of soil*	
----------	----------	100	45–90	7–12	0.63–2.0	0.20–0.22	Low.
----------	100	95–100	30–60	7–12	2.0–6.3	0.15–0.17	Low.
100	95–100	90–95	0–10	3–10	6.3–20.0	0.05–0.07	Very low.
----------	----------	100	95–100	15–27	0.63–2.0	0.22–0.24	Moderate.
----------	----------	100	95–100	20–32	0.63–2.0	0.18–0.20	Moderate to high.
----------	----------	100	95–100	12–27	0.63–2.0	0.20–0.22	Moderate.
----------	100	90–100	0–10	3–10	6.3–20.0	0.06–0.08	Very low.

[3] Subject to flooding.
[4] Fine sand is below the depth normally sampled.

interpretations

soils in such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the that appear in the first column of this table]

Soil features affecting—Continued						Degree and kind of limitation for sewage disposal	
Farm ponds		Agricultural drainage	Irrigation	Terraces and diversions	Grassed waterways	Filter fields	Sewage lagoons
Reservoir area	Embankment						
High seepage.	Fair to poor stability; fair to good compaction characteristics; pervious; slight compressibility; erodible slopes require protection; subject to seepage.	Excessive drainage.	(2)	(2)	(2)	Slight to severe, depending on slope.	Severe: rapid permeability; requires sealing or lining.
Water table at a depth of 2 to 6 feet; dugouts.	Fair stability; good compaction characteristics; pervious; slight compressibility; erodible slopes; may be subject to seepage; wet borrow areas possible.	Seasonal high water table and occasional overflow; good internal drainage; in places suitable outlets not available.	Low available water capacity; moderately rapid to rapid intake rate; adequate drainage necessary; subject to soil blowing.	(2)	Erodible; in places requires water-tolerant grasses; cuts may expose sand; fertility generally low in cuts.	Severe: water table at a depth of 2 to 6 feet; possible flooding.	Severe: rapid permeability; in places requires protection from overflow; requires sealing or lining.
Moderate seepage.	Good stability; compaction control good with moisture; low compressibility; impervious.	Good drainage.	High available water capacity; subject to soil blowing and water erosion; slopes erodible.	Slopes subject to soil blowing and water erosion.	Erodible.	Slight.	Severe: moderate permeability; use lower layers for sealing or lining.
Moderate seepage; in places has high vertical permeability.	Fair to good stability and compaction characteristics; impervious; medium to high compressibility; slopes erodible.	Good to somewhat excessive drainage; rapid surface runoff.	High available water capacity; slopes erodible. [2]	Highly erodible; siltation of channels; in places irregular slope length makes alinement difficult.	Highly erodible; in places cuts low in fertility.	Moderate if slope is 8 to 15 percent, severe if more than 15 percent; moderate permeability.	Severe: slopes; moderate permeability; requires sealing or lining.

TABLE 7.—*Engineering*

Soil series and map symbols	Suitability as source of—					Soil features affecting—		
	Topsoil	Sand or mixed sand and gravel	Road subgrade		Road fill	Highway location	Foundations	Dikes and levees
			Paved roads	Gravel roads				
Darr: Da, Db	Fair	Good for sand below a depth of 2 feet.	Good to fair.	Fair to poor.	Fair to good: susceptible to frost action if upper 2 feet is used on top of fill.	Moderate to low susceptibility to frost heave; in places lower areas require minimum fills where subject to overflow; erodible if exposed on embankment.	Good to poor bearing capacity, depending on density and if confined; in places subject to seepage.	Slopes erodible; in places subject to seepage.
Detroit: De	Fair	(1)	Poor	Good	Poor: requires close compaction control; subject to frost heave and shrink swell.	High susceptibility to frost heave; in places occasional flooding requires 4- to 7-foot fills; moderate to high shrink swell.	Fair to poor bearing capacity; may crack when dry; subject to frost heave and shrink swell.	Slopes erodible; may crack when dry.
Elsmere: Ea	Fair	Good for sand below a depth of 2 feet.	Good	Poor	Fair: slopes erodible; good if confined and compacted; somewhat poor drainage.	Erodible on embankments; seasonal high water table or occasional flooding requires 4- to 7-foot fills; moderate to low suceptibility to frost heave.	Good to fair bearing capacity, depending on density and if confined; in places subject to seepage.	Slopes erodible; in places requires slope protection; in places subject to seepage.
Geary: GsC3, GsD3	Poor: low fertility; thin surface layer.	(1)	Poor	Good	Fair with adequately controlled compaction.	High susceptibility frost heave; slopes erodible; cuts and fills necessary because of topography.	Fair to poor bearing capacity; moderate to high shrink swell.	(2)
Gibbon: Gg	Fair: in places wet.	In places sand is available below a depth of 5 feet.	Fair to poor.	Good to fair.	Fair if drained; poor for fills less than 3 feet in depth.	High susceptibility to frost heave; seasonal high water table or occasional flooding requires 4- to 7-foot fills; slopes erodible.	Fair to poor bearing capacity; water table at a depth of 2 to 6 feet.	Slopes erodible
Grigston: Gk	Fair	In places sand is available below a depth of 5 feet.	Fair to poor.	Good to fair.	Fair with controlled compaction; subject to frost heave if not drained.	Susceptible to frost heave; slopes erodible.	Fair to good bearing capacity.	Slopes erodible
Hall: Ha	Good	(1)	Fair to poor.	Good to fair.	Fair with adequately controlled compaction.	Susceptible to frost heave: slopes erodible; in places infrequent flooding requires minimum fills.	Fair to poor bearing capacity depending on density and moisture in the foundation.	Slopes erodible; may crack when dry.
Hastings: Hs	Fair	(1)	Fair to poor.	Good to fair.	Fair with adequately controlled compaction.	High susceptibility to frost heave; slopes erodible.	Fair to good bearing capacity if dry.	Slopes erodible; may crack if dry.

See footnotes at end of table.

interpretations—Continued

Soil features affecting—Continued							Degree and kind of limitation for sewage disposal	
Farm ponds		Agricultural drainage	Irrigation	Terraces and diversions	Grassed waterways	Filter fields	Sewage lagoons
Reservoir area	Embankment							
High seepage	Fair to good stability; in places requires close compaction control; fair to good compaction characteristics; slight compressibility; in places requires foundation drains.	Good drainage	Low available water capacity; adequate drainage necessary; moderately rapid intake rate.	(²)	Erodible; in places cuts expose sand; fertility low where subsoil exposed.	Slight, but moderate if subject to overflow.	Severe: moderately rapid permeability in places requires protection from overflow; rapid permeability in underlying material; requires sealing or lining.
Low seepage	Fair stability and compaction characteristics; impervious; medium to high compressibility; slopes erodible.	Moderately good drainage; slow internal drainage.	High available water capacity; slow intake rate.	Diversion slopes erodible.	Erodible; in places cuts expose clayey subsoil.	Severe: slow permeability.	Slight: in places requires protection from flooding.
High seepage; water table at a depth of 2 to 6 feet; dugouts.	Fair stability; good compaction characteristics; pervious; low compressibility; slopes erodible; may be wet in borrow areas.	Water table at a depth of 2 to 6 feet; good internal drainage.	Low available water capacity; moderately rapid to rapid intake rate; adequate drainage necessary; subject to soil blowing.	(²)	Highly erodible; in places cuts expose sand; in places fertility low where subsoil exposed; in places requires water-tolerant grasses.	Severe: water table at a depth of 2 to 6 feet.	Severe: rapid permeability; requires sealing or lining; in places requires protection from flooding.
Low to moderate seepage.	Fair to good stability and compaction characteristics; impervious; medium to high compressibility; slopes erodible.	Good drainage; medium internal drainage; rapid surface runoff.	Subject to water erosion; high available water capacity; low fertility; unit GsD3 not suited.	Highly erodible; in places siltation of channels; irregular slopes make alinement difficult in places.	Moderately erodible; in places low in fertility; medium and rapid runoff rate.	Severe: moderately slow permeability; slopes.	Severe: slopes.
Low to moderate seepage; water table at a depth of 2 to 6 feet; dugouts.	Fair to good stability; fair compaction characteristics; impervious; medium to high compressibility; in places requires foundation drains; wet borrow areas.	Slow surface drainage; subject to water table at a depth of 2 to 6 feet; occasional overflow; in places suitable outlets not available.	High available water capacity; moderate to moderately slow intake rate; adequate drainage necessary.	Diversion slopes erodible; occasional overflow.	Erodible; in places requires water-tolerant grasses.	Severe: water table at a depth of 2 to 6 feet.	Severe: moderate permeability; requires sealing or lining; in places requires protection from flooding.
Low to moderate seepage.	Fair to good stability and compaction characteristics; medium compressibility; slopes erodible.	Good surface drainage.	High available water capacity; moderate to moderately slow intake rate.	Diversion slopes erodible.	Erodible	Moderate: moderate permeability.	Severe: moderate permeability; requires sealing or lining.
Low to moderate seepage.	Fair to good stability and compaction characteristics: impervious; medium to high compressibility; slopes erodible.	Generally good drainage.	High available water capacity; moderately slow intake rate.	Diversion slopes erodible.	Erodible	Moderate: moderately slow permeability.	Slight: moderately slow permeability within a depth of 4 feet; excavations deeper than 4 feet require sealing or lining.
Low to moderate seepage.	Fair to good stability and compaction characteristics; impervious; medium to high compressibility; slopes erodible; fair workability.	Slow surface runoff; medium internal drainage.	High available water capacity; moderately slow intake rate.	Moderately erodible.	Erodible; in places fertility low in deeper cuts.	Moderate: moderately slow permeability.	Slight: moderately slow permeability; requires sealing or lining if excavation exceeds a depth of 2 feet.

TABLE 7.—*Engineering*

Soil series and map symbols	Suitability as source of—					Soil features affecting—		
	Topsoil	Sand or mixed sand and gravel	Road subgrade		Road fill	Highway location	Foundations	Dikes and levees
			Paved roads	Gravel roads				
Hobbs: Hb, 2Hb, HbA, HbB	Good	([1])	Fair to poor.	Good to fair.	Fair with adequately controlled compaction.	Susceptible to frost heave; occasional flooding requires 4- to 7-foot fills in some areas; slopes erodible.	Fair to good bearing capacity; subject to some flooding.	Slopes erodible.
Holder: Hg, HgA, HgB2, HgC, HpC2, HpC3.	Fair	([1])	Fair to poor.	Good to fair.	Fair with controlled compaction and drainage.	Susceptible to frost heave; slopes erodible; some cuts and fills may be required because of steep topography.	Fair to good bearing capacity if dry.	Slopes erodible.
Hord: Hd	Good	([1])	Fair to poor.	Good to fair.	Fair with adequately controlled compaction.	Susceptible to frost heave; slopes erodible.	Fair to good bearing capacity depending on moisture and density.	Slopes erodible.
Inavale: Ia, If, Ig, In	Poor: low fertility; coarse texture in places.	Good for sand below a depth of 1 foot.	Good	Poor	Good: subject to erosion on slopes.	Moderate to low susceptibility to frost heave; lower areas require minimum fills where subject to overflow; erodible if exposed on cut slopes.	Generally good bearing capacity if confined; in places subject to seepage; subject to some flooding.	Slopes erodible; subject to seepage.
Kenesaw: Ks, KsB, KsC, KSz. Onsite determination is needed for Slickspots part of KSz.	Fair	In places fine sand available below a depth of 5 feet.	Fair to poor.	Good to fair.	Fair with adequately controlled compaction; good below a depth of 4 feet.	Susceptible to frost heave; slopes erodible; in places some high cuts and fills needed because of topography.	Fair bearing capacity depending on density.	Slopes erodible.
Lamo: La	Good	In places sand with some gravel layers available below a depth of 5 feet.	Poor	Good	Poor: water table at a depth of 2 to 6 feet; high clay content.	High susceptibility to frost heave; in places water table at a depth of 2 to 6 feet; occasional flooding requires 4- to 7-foot fills; slopes erodible.	Fair to poor bearing capacity; water table at a depth of 2 to 6 feet.	Slopes erodible; may crack if dry.
*Libory: LB, LC. For Boelus part of LB and LC, see Boelus series.	Fair	In places sand available below a depth of feet.	Fair to poor.	Poor to fair.	Good in upper 1½ feet; fair to poor below a depth of 1½ feet.	Moderate to high susceptibility to frost heave, depending on depth of surface sands; erodible embankments.	Fair to poor bearing capacity.	Slopes erodible; in places subject to seepage in the sandy surface layer.

See footnotes at end of table.

interpretations—Continued

Soil features affecting—Continued						Degree and kind of limitation for sewage disposal	
Farm ponds		Agricultural drainage	Irrigation	Terraces and diversions	Grassed waterways	Filter fields	Sewage lagoons
Reservoir area	Embankment						
Low to moderate seepage.	Fair to good stability and compaction characteristics; impervious; medium compressibility; slopes erodible; fair workability.	Generally good drainage subject to some overflow.	High available water capacity; moderate to moderately slow intake rate; in places requires protection from overflow; slopes erodible.	Diversion slopes erodible; subject to occasional overflow and channel siltation.	Moderately erodible; in places requires some protection from flooding.	Moderate: moderate permeability; severe if subject to overflow.	Severe: moderate permeability; requires sealing or lining if excavation exposes layer of more permeable soils; requires protection from flooding.
Low to moderate seepage.	Fair to good stability and compaction characteristics; impervious; medium compressibility; slopes erodible; fair workability.	Generally good drainage.	High available water capacity; moderate to moderately slow intake rate; slopes erodible.	Moderately erodible; siltation of channels on steeper slopes.	Erodible; in places fertility low in deeper cuts.	Moderate: moderately slow permeability.	Slight to moderate: slopes; moderately slow permeability; requires sealing or lining if excavations below a depth of 4 feet.
Low to moderate seepage.	Fair to good stability and compaction characteristics; impervious; compaction control required; medium compressibility; slopes erodible.	Generally good drainage.	High available water capacity; moderate to moderately slow intake rate.	Slopes erodible.	Erodible.	Moderate: moderate permeability.	Severe: moderate permeability; requires sealing or lining.
High seepage.	Good stability; lesser slopes required; good compaction characteristics; pervious; very slight compressibility; erodible slopes.	Excessive drainage.	(2)	Sandy underlying material within a depth of 1½ feet; diversion slopes subject to soil blowing and water erosion.	Erodible; in places cuts expose sand; fertility low where subsoil exposed; generally droughty; in places vegetation is difficult to establish.	Slight: moderate if subject to overflow; severe hazard of contamination.	Severe: rapid permeability; requires sealing or lining; requires protection from flooding.
Low to moderate seepage in upper 4 feet.	Fair to good stability and compaction characteristics; impervious; medium compressibility; slopes erodible; pervious if borrow taken below a depth of 4 feet.	Generally good drainage.	High available water capacity; moderate intake rate.	Moderately to highly erodible; steep slopes in places.	Erodible; in places fertility low in deeper cuts.	Moderate: moderate permeability and slopes.	Severe: moderate permeability and slopes; requires sealing or lining.
Low seepage; water table at a depth of 2 to 6 feet; dugouts.	Fair stability and compaction characteristics; impervious; medium to high compressibility; wet borrow areas.	Seasonal high water table and occasional overflow; slow internal drainage; in places adequate outlets not available.	High available water capacity; moderately slow intake rate; adequate drainage necessary.	(1)	Erodible; only water-tolerant grasses grow in places.	Severe: water table at a depth of 2 to 6 feet; moderately slow permeability.	Severe: water table at a depth of 2 to 6 feet.
Low vertical seepage.	Fair to good stability and compaction characteristics; medium compressibility; moderately impervious; in places requires seepage control; slopes erodible.	Moderately good drainage.	High available water capacity; subject to erosion by water and soil blowing.	Slopes erodible; soil blowing and water erosion in some places.	Erodible; fertility generally low in cuts; generally somewhat droughty.	Moderate: moderate permeability.	Severe: moderate permeability; slight if lower horizon used as compacted soil liner.

TABLE 7.—*Engineering*

Soil series and map symbols	Suitability as source of—					Soil features affecting—		
	Topsoil	Sand or mixed sand and gravel	Road subgrade		Road fill	Highway location	Foundations	Dikes and levees
			Paved roads	Gravel roads				
Loretto: L	Poor: coarse-textured surface layer; fair at a depth of more than 1 foot.	In places sand available below a depth of 5 feet.	Good to poor.	Poor to good.	Fair in upper 1½ feet; fair to poor below a depth of 1½ feet.	Moderate to high susceptibility to frost heave; slopes erodible.	Fair to poor bearing capacity.	Slopes erodible; in places subject to seepage.
Marsh: M. No interpretations. Properties too variable.								
Nuckolls: NsD3	Poor: low fertility.	(1)	Poor	Good	Fair with controlled compaction.	High susceptibility to frost heave; slopes erodible; cuts and fills necessary because of topography.	Fair to good bearing capacity if maintained dry.	(2)
O'Neill: Ok	Good for upper 1 foot.	Good for fine and coarse sand below a depth of 2 feet.	Fair to good.	Poor to fair.	Fair to good	Moderate to low susceptibility to frost heave; loose sand below a depth of 2 feet may hinder hauling operations; slopes erodible.	Good bearing value if confined.	Slopes erodible; limited material above sands.
Ord: Oe, Of	Fair	Good for sand below a depth of 2 feet.	Fair to good.	Fair to poor.	Fair to good: water table at a depth of 2 to 6 feet.	Moderate to low susceptibility to frost heave; water table at a depth of 2 to 6 feet; requires fills 4 to 7 feet deep; erodible if exposed on embankments.	Good to poor bearing capacity, depending on density and if confined; in places subject to piping; water table at a depth of 2 to 6 feet.	Slopes erodible; in places subject to piping.
*Ortello: ObB, OrA, Ot, OtB, OxD. For Coly part of OxD, see Coly series.	Good	Good for fine sand below a depth of 3 feet.	Fair to good.	Fair to poor.	Good with controlled compaction; fair for erodible slopes.	Moderate susceptibility to frost heave; erodible if exposed on embankments.	Good to fair, depending on density and if confined.	Slopes erodible.
Ovina: Oa	Fair	In places sand available below a depth of 5 feet.	Good to poor.	Poor to good.	Good to fair: borrow areas wet in places.	Moderate to low susceptibility to frost heave; water table at a depth of 2 to 6 feet; occasional flooding; requires fills 4 to 7 feet deep; slopes erodible.	Fair bearing capacity; water table at a depth of 2 to 6 feet; subject to seepage.	Slopes erodible; in places subject to seepage.
Rough broken land, loess: RB.[1] No interpretations. Properties too variable.								

See footnotes at end of table.

interpretations—Continued

Soil features affecting—Continued						Degree and kind of limitations for sewage disposal	
Farm ponds		Agricultural drainage	Irrigation	Terraces and diversions	Grassed waterways	Filter fields	Sewage lagoons
Reservoir area	Embankment						
Low to moderate vertical seepage.	Fair to good stability and compaction characteristics; slight to medium compressibility; moderately impervious; slopes erodible; close control of borrow areas required.	Generally good drainage.	High available water capacity; moderate intake rate; subject to soil blowing.	Slopes erodible.	Erodible; in places fertility low in cuts.	Moderate: moderate permeability; location of clay percentage affects design.	Severe: moderate permeability within a depth of 1½ feet; slight if lower soils used as compacted soil liner.
Moderate seepage.	Fair to good stability and compressibility; slopes erodible; fair to good workability.	Rapid surface runoff.	(2)	Moderately erodible.	Erodible; fertility low in deep cuts.	Severe: slopes; moderately slow permeability.	Severe: slopes.
Moderate seepage; high if sand is exposed.	Fair to good stability; good compaction characteristics; moderately pervious; slight compressibility; subject to seepage; requires control of borrow areas.	Somewhat excessive drainage.	Low available water capacity; moderate to moderately rapid intake rate; subject to soil blowing.	Erodible; sandy substratum within a depth of 2 feet.	Erodible; low fertility if sand or gravel is exposed in cuts.	Slight.	Severe: moderately rapid permeability; requires sealing or lining.
Moderate to high seepage.	Fair to poor stability; fair to good compaction characteristics; slight to very slight compressibility; in places subject to piping; water table at a depth of 2 to 6 feet.	Water table at a depth of 2 to 6 feet; occasional overflow; rapid internal drainage; in places suitable outlets not available.	Moderate to low available water capacity; moderately rapid intake rate; adequate drainage necessary.	Sandy underlying material within a depth of 2 feet; diversion slopes erodible.	Erodible; in places requires water-tolerant grasses; in places cuts expose sand; generally low fertility in cuts.	Severe: water table at a depth of 2 to 6 feet.	Severe: moderately rapid permeability; in places requires protection from overflow.
Moderate seepage; high where sand is exposed.	Fair to good stability; good compaction characteristics; moderately pervious; slight compressibility; subject to horizontal seepage; slopes erodible.	Good drainage.	Moderate available water capacity; moderate to moderately rapid intake rate; subject to soil blowing.	Slopes erodible; sandy substratum within a depth of 2 feet.	Erodible; low fertility if sand is exposed; in places somewhat droughty.	Slight.	Severe: moderately rapid permeability; requires sealing or lining.
Low to moderate seepage; water table at a depth of 2 to 6 feet; dugouts.	Fair to good stability and compaction characteristics if closely controlled; slight to medium compressibility; moderately impervious; slopes erodible; wet borrow areas.	Somewhat poor drainage; water table at a depth of 2 to 6 feet; occasional overflow; in places suitable outlets not available.	Moderate available water capacity; rapid to moderately rapid intake rate; subject to soil blowing; adequate drainage necessary.	(2)	Erodible; in places requires water-tolerant grasses or drainage.	Severe: water table at a depth of 2 to 6 feet.	Severe: water table at a depth of 2 to 6 feet; moderately rapid permeability; subject to flooding.

TABLE 7.—*Engineering*

Soil series and map symbols	Suitability as source of—					Soil features affecting—		
	Topsoil	Sand or mixed sand and gravel	Road subgrade		Road fill	Highway location	Foundations	Dikes and levees
			Paved roads	Gravel roads				
Rusco: Ru	Fair	In places sand available below a depth of 5 feet.	Poor to fair.	Fair to good.	Fair to poor, depending on percent clay present in fill.	High susceptibility to frost heave; slopes erodible; occasional flooding in some areas; in places requires minimum fills.	Fair to good bearing capacity; subject to occasional flooding.	Slopes erodible.
Silty alluvial land: Sy. No interpretations. Properties too variable.								
Silver Creek: SS. Mapped only with Slickspots.	Fair	Sand with some gravel layers may be available below a depth of 5 feet.	Poor to fair.	Fair to good.	Fair to poor, depending on use of clay layers in borrow area.	High susceptibility to frost heave; slopes erodible; occasional flooding in some areas; in some places requires minimum fills.	Fair to poor bearing capacity.	Slopes erodible.
Simeon: Sm	Poor: coarse; low fertility.	Good for sand containing small amounts of gravel below a depth of 1 foot.	Good	Poor	Good: use vibratory compaction and flat slopes.	No or little frost heave; highly erodible on exposed embankments; loose; in places dry sand hinders hauling operations.	Good bearing capacity if confined.	Slopes erodible.
Thurman: TfB, ThA, ThB, 2ThA.	Poor: coarse.	Sand containing small amounts of silt and clay throughout profile except in 2ThA.	Fair to good.	Fair to poor.	Good: use flatter than normal slopes.	Low susceptibility to frost heave; erodible on exposed embankments; in places loose dry sand hinders hauling operations.	Good to fair depending on density and if confined.	Slopes erodible; requires flatter slopes.
Tryon: 2To, Ty	Poor: poor drainage.	Good for sand below a depth of 1 foot.	Good	Poor	Fair: material good; slopes erodible; borrow areas have high water table.	Low susceptibility to frost heave; water table at surface or within a depth of 30 inches; occasional flooding; requires 4- to 7-foot fills; erodible slopes.	Good bearing capacity if confined; may be subject to seepage; water table at surface or within a depth of 30 inches.	Slopes erodible; in places subject to horizontal seepage; high water table.
Uly: UsC, UsD	Fair	(1)	Fair to poor.	Good to fair.	Fair with adequately controlled compaction.	High susceptibility to frost heave; erodible on exposed embankments; some high cuts and fills required because of topography; in places foundations have high consolidation potential.	Fair to good bearing capacity, depending on moisture and density.	(2)

See footnotes at end of table.

interpretations—Continued

Soil features affecting—Continued						Degree and kind of limitations for sewage disposal	
Farm ponds		Agricultural drainage	Irrigation	Terraces and diversions	Grassed waterways	Filter fields	Sewage lagoons
Reservoir area	Embankment						
Low seepage	Fair to good stability and compaction characteristics; impervious; medium compressibility; slopes erodible.	Moderately good drainage; medium internal drainage; subject to some overflow.	High available water capacity; moderately slow intake rate; adequate surface drainage necessary.	(²)	Erodible; in places low fertility if subsoil exposed.	Severe: moderately slow permeability; subject to overflow.	Moderate or severe: in places requires protection from overflow; use existing soil for a compacted seal or liner.
Low seepage	Fair to good stability and compaction characteristics; impervious; medium compressibility; slopes erodible.	Somewhat poor drainage; slow internal drainage; subject to some overflow.	High available water capacity; slow intake rate; in places requires protection from overflow; adequate surface drainage needed.	(²)	Erodible; in places cuts expose clayey subsoil.	Moderate: moderately slow permeability; subject to overflow.	Severe: in places requires protection from overflow; moderate permeability below a depth of 2 feet.
High seepage.	Fair to good stability; good compaction characteristics; pervious; slight compressibility; slopes erodible; good workability; fills need flatter than normal slopes.	Excessive drainage; very rapid internal drainage.	(²)	Highly erodible; shallow.	Highly erodible; low fertility; droughty; vegetation difficult to establish.	Slight: trench cuts may cave or sluff; severe hazard of groundwater contamination.	Severe: rapid permeability; requires sealing or lining.
High seepage; dugout may be possible.	Fair to good stability; good compaction characteristics; pervious; slight compressibility; slopes erodible; needs flatter than normal slopes.	Somewhat excessive drainage; rapid internal drainage.	Low available water capacity; rapid intake rate; subject to soil blowing.	Slopes erodible; soil blowing and siltation in some areas; irregular topography makes alinement difficult.	Erodible; low fertility; generally droughty.	Slight if slope is less than 8 percent, moderate if more than 8 percent.	Severe: rapid premeability; requires sealing or lining.
High to moderate seepage; dugouts possible.	Fair stability; good compaction characteristics; pervious; slight compressibility; in places subject to seepage; wet borrow areas.	Water table at surface or within a depth of 30 inches; subject to occasional overflow; in places suitable outlets not available; Tr poorly drained.	(²)	(²)	Erodible; generally requires water-tolerant grasses; in places cuts expose sand.	Severe: water table at surface or within a depth of 30 inches; subject to flooding.	Severe: rapid permeability; flooding; water table at surface or within a depth of 30 inches.
Low to moderate seepage.	Good stability and compaction characteristics; impervious; medium compressibility; slopes erodible; control fill moisture.	Good or somewhat excessive drainage; medium to rapid surface runoff.	High available water capacity; moderate intake rate; slopes erodible; UsD not suited.	Moderately erodible; some siltation; in places irregular slope lengths make good alinement difficult.	Moderately erodible; cuts may be low in fertility.	Moderate if slope is 8 to 15 percent, severe if more than 15 percent; moderate permeability.	Moderate to severe: moderate permeability and slopes; requires sealing or lining.

TABLE 7.—*Engineering*

Soil series and map symbols	Suitability as source of—					Soil features affecting—		
	Topsoil	Sand or mixed sand and gravel	Road subgrade		Road fill	Highway location	Foundations	Dikes and levees
			Paved roads	Gravel roads				
*Valentine: VaC, VTD. For Thurman part of VTD, see Thurman series.	Poor: low available water capacity; coarse; thin.	Good for sand below a depth of 1 foot.	Good	Poor	Good: slopes erodible; use nearly level slopes.	Low susceptibility to frost heave; highly erodible on exposed slopes; requires protective cover; in places loose dry sand hinders hauling operations; high cuts and fills required because of topography.	Good to fair depending on density; must be confined.	(1)

[1] Fine sand and sand and gravel are generally not available.

A sand-silt-clay soil is further classified by identifying the silt-clay portion. Thus, an A-2-4 soil is an A-2 sand with an A-4 type of silt-clay mixture included.

The group index number (shown in parentheses in table 5) ranges from 0 to 20, and is a rating of field performance of the soil. Thus, an A-2-4 (0) soil is one of the best for highway construction. A group index number of 20 would be one of the least desirable soils for highway location or construction.

The Nebraska Department of Roads uses a group index of −4 to 32 instead of 0 to 20. This enlarged group index bracket allows (a) the plastic and nonplastic fine-grained soil occuring in sands to be evaluated and (b) the effect of a high clay content (group index greater than 20) to be determined.

THE UNIFIED SOIL CLASSIFICATION SYSTEM.—Many organizations, including the Soil Conservation Service, U.S. Bureau of Reclamation, Corps of Engineers, and other engineers, use the Unified System (*12*). Soils are classified generally as coarse grained, fine grained, and organic or peat.

Fine-grained soils are classified according to plasticity characteristics. Coarse-grained soils are classified primarily according to gradation, and organic soils are classified according to odor and plasticity change after ovendrying.

Combinations of letters are used to identify soil materials and certain properties in the Unified System. G is used for gravel, S for sand, C for clay, M for silt, W for well-graded, P for poorly-graded, L for low liquid limit, and H for high liquid limit.

Two letters are combined to classify the soil; for example: SP is a sand, poorly graded; CL is a clay of low plasticity; and GC is a gravel-clay mixture. There are twelve possible inorganic classifications, and three possible organic classifications. Organic (OL and OH) and peat (Pt) soils are uncommon in Nebraska.

In table 6 and 7, the soils of Howard County are classified as SP, SP-SM, SM, ML, ML-CL, CL, and CH. Soils that have borderline characteristics of two classifications are given a dual classification.

Engineering test data

Table 5 shows engineering test data for 29 soil samples representing 11 soil series. The tests were made by the Division of Materials and Tests, Nebraska Department of Roads, according to standard procedures of the American Association of State Highway Officials.

Each soil listed in table 5 was sampled at only one location, and the data given for the soil are those at the location. From one location to another, a soil can differ considerably in characteristics that affect engineering. Even if soils are sampled at more than one location, the test data probably do not show the widest range in characteristics.

The engineering classifications in the last two columns of table 6 are based on data obtained by mechanical analysis and on tests to determine the liquid limit and plastic limit. The mechanical analysis was made by a combination of the sieve and hydrometer methods.

Tests for liquid limit and plastic limit measure the effect of water on the consistency of the soil material. As moisture content of a clay soil is increased from a dry condition, the soil changes from a solid to a liquid state. Plastic limit is the moisture content, expressed as a percentage of the ovendry weight of the soil, at which the soil passes from a solid to a plastic state. Liquid limit is the moisture content at which the soil passes from a plastic to a liquid state. The plasticity index is the numerical difference, in percent moisture, between the liquid limit and plastic limit. It indicates a range of moisture content within which a soil is in a plastic condition. Some silty and sandy soils are nonplastic, which means they will not become plastic at any moisture content.

Engineering properties

In table 6 soil properties significant to engineering are estimated. For detailed information about the soils, refer to the section "Descriptions of the Soils," and for information about geology, to the section "Formation and Classification of the Soils."

The estimates in table 6 were based on the engineering test data in table 5 and on other information obtained in

interpretations—Continued

Soil features affecting—Continued						Degree and kind of limitation for sewage disposal	
Farm ponds		Agricultural drainage	Irrigation	Terraces and diversions	Grassed waterways	Filter fields	Sewage lagoons
Reservoir area	Embankment						
High seepage.	Good stability on flatter slopes; good compaction characteristics; pervious; slight compressibility; slopes erodible; in places subject to seepage if water impounded.	Excessive drainage; rapid internal drainage.	(3)	Slopes highly erodible; irregular topography makes good alinement difficult.	Erodible; low fertility; droughty; vegetation difficult to establish.	Slight if slope is less than 8 percent, moderate if more than 8 percent.	Severe: rapid permeability and slopes; requires sealing or lining.

[3] Generally not necessary or applicable because of topography, slope, or soil characteristics.

the county during the survey. The data are listed by strata that have properties significant to engineering. These data include the textural classification of the United States Department of Agriculture and the AASHO and Unified engineering classifications. Also listed for each layer are the percentages of material that will pass sieve numbers 4, 10, 40 and 200, and the percent finer than 0.002 mm. as determined by the hydrometer method. Estimates of the percentage passing the sieves are based on the assumption that material up to and including 3 inches in diameter equals 100 percent. There are no soils in Howard County that have a significant percentage of coarse materials greater than 3 inches.

In the AASHO and Unified systems, soil particles retained on the number 200 sieve are classified as sand and gravel. Silt and clay particles will pass through this sieve. The range of values shown in table 6 for the percent of soil finer than 0.002 millimeter represents the estimated clay fraction of the soil. Silt and clay particles can affect such properties as strength, permeability, compaction, and shrink-swell potential.

In tables 5 and 6, the clay percentage is based on an analysis which uses the hydrometer method (AASHO Designation T-88). This method can give results that differ slightly from those obtained with the pipette method used by SCS soil scientists to obtain results with standard soil survey procedures.

In table 6, permeability refers to the rate at which water moves through a saturated soil. It depends largely on gradation, structure, and density. The rate is given in inches of water per hour. Rates are given for the major significant soil horizons. Terms used to describe permeability and the equivalent rates are given in the Glossary.

Available water capacity, estimated in inches of water per inch of soil depth, is the approximate amount of capillary water in a soil that is wet to field capacity. When soil is air dry, this amount of water will wet it to a depth of 1 inch without deeper percolation.

Soil dispersion is not a serious problem because few areas contain enough salts to produce moderate dispersion. Salinity is generally not a problem. The soil material in Slickspots is high in exchangeable sodium (alkaline). Onsite investigation is needed in all areas where salinity poses a hazard to construction work.

A general rating for shrink-swell potential is given in table 6. Several soils, such as those in the Detroit, Gibbon, and Holder series, have moderate to high shrink-swell potential. Generally, soils that have a high clay content undergo a volume change when the soil moisture is changed. Clean sand and gravel undergo little or no volume change with a change in soil moisture.

Reaction is the degree of acidity or alkalinity, expressed as a pH value or reaction class. A soil that has a value of 7.0 is neutral; one of lower value is acid, and one of higher value is alkaline. In Howard County most of the soils have pH values higher than 7.8 and should be investigated for potential corrosive hazard to metal structures. The reaction value in most horizons of the representative profile are given in the section "Descriptions of the Soils." Soils used as construction materials, when moist or wet, should be tested for corrosive potential.

Engineering interpretations of soils

Table 7 indicates a general interpretation of the soils for their use in engineering. This table is a guide to planning and further investigation of the soils. Onsite determination of the soils for type, quantities, and engineering properties is important.

In table 7 topsoil is rated *good*, *fair*, or *poor*, depending on fertility, content of organic matter, erodibility, and workability. Topsoil is used on road and dam embankments, excavated slopes, and gardens and lawns.

Several soils in Howard County are a source of sand and gravel, for example, Boel, Inavale, and Simeon soils. Exploration is needed to determine quantity and gradation. The data in table 7 indicate that little, if any, gravel is present in the soils sampled. Gravel (particles retained on a number 4 sieve) is available below a depth of 5 feet in some places.

Sand and gravel are rated *good* to *fair* for subgrades under pavement and *poor* for gravel road subgrades. Silt and clay on the road subgrade surface is more stable for

gravel surfacing. Thus, for paved roads, AASHO class soils A–1 and A–3 are rated *good;* A–2, *good* to *fair;* A–4, *fair* to *poor;* and A–6 or A–7, *poor.* For most soils the road subgrade (foundation) and road fill use the same classification for paved roads because the engineering requirements are approximately the same.

Ratings for use of soil as road fill reflect the performance of the soil as embankments, as a foundation for embankments, and as a cut slope. The soil's susceptibility to frost action is also rated. Sand and gravel are rated *good* to *fair* for subgrades under pavement and *poor* for gravel road subgrades. Silt and clay on the road subgrade surface is more stable for gravel surfacing. Thus, for paved roads, AASHO class soils A–1 and A–3 are rated *good;* A–2, *good* to *fair;* A–4, *fair* to *poor;* and A–6 or A–7, *poor.* For most soils the road subgrade (foundation) and road fill use the same classification for paved roads because the engineering requirements are approximately the same.

Highway locations are described according to potential problems of frost heave, shrink-swell, erodibility of cut and fill slopes, and location of water table. Soils are rated as *good*, *fair*, or *poor* for road subgrade. Frost action is caused by the expansion of freezing water in silt-clay soils which, in turn, increases maintenance of paved roads. A high water table can contribute to potential frost action or frost heave.

Foundations are rated generally on bearing or load-carrying capacity. Most soils have a high bearing capacity when dry. Some of the windblown soils are subject to high consolidation when saturated under load. Sand and gravel (see AASHO classifications) have high bearing capacity when confined. Specific values for bearing capacity (for example, pounds per square inch) should not be assigned to estimated values as expressed in words in table 6. Wet excavations for buildings may be a problem. Therefore, depth to water should be determined for building sites. The potential for shrink-swell from table 6 is important also to foundations.

Dikes and levees are used to control surface water. They are subject to erosion by wind, water, and horizontal seepage if constructed of clean sands or if the material is not properly compacted. Some soils are subject to shrinkage cracking upon drying. Dikes and levees constructed of sandy soils are more stable if slopes are smooth. Steeper slopes are used for dikes and levees constructed of clay because the fill is relatively impervious to water.

Potential seepage in the soil and soil characteristics that affect embankments are described in table 7 under the heading "Farm ponds." A high water table indicates the possibility of excavating a dugout for a water supply. A low water table may indicate the need for sealing or lining a pond; it also indicates that construction of a fill may be easier because of a drier foundation.

Embankments are subject to seepage and compressibility. These factors are rated in table 7. Workability includes hauling and compaction characteristics. Potential seepage depends on moisture, gradation, and compaction of the fill. Two methods of compaction are required for soils in Howard County. See table 5 for test results giving maximum dry densities for particular samples. Soils containing approximately 15 percent or less of silt and clay particles should have compaction controlled by the relative density test. This test is equivalent to the use of vibratory rather than sheepsfoot rollers. The erodibility of fill slopes is also described.

Agricultural drainage, as described in table 7, depends on the depth to the water table, available outlets, and permeability of the various soil layers.

Suitability of soils for irrigation is affected by such factors as available water capacity, permeability, surface intake rate, steepness of slope, and possible limiting depth of leveling cuts. Further information on irrigation is contained in "Irrigation Guide for Nebraska" (*11*). The ratings for available water capacity are limited to the top 5 feet of soil. The rating is *high* if the soil will hold more than 9 inches of water; *moderate* if it holds 6 to 9 inches; *low* if it holds 3 to 6 inches; and *very low* if it holds less than 3 inches. Intake rate is the rate of movement of water into the soil. The intake rate is affected by the permeability of the various soil layers being irrigated. Intake ratings are given for some soils in table 7. The permeability range is given in table 6. The intake rate is *rapid* if the soil absorbs more than 2 inches of water per hour; *moderate* if the rate is from 0.5 to 2 inches per hour; and *slow* if less than 0.5 inch per hour.

Use of the soils for terraces, diversions, and grassed waterways is influenced by the susceptibility of the soil to water erosion and soil blowing, the difficulty of establishing vegetation, and the soil fertility. Maintenance costs of terraces and diversions are greater where siltation from higher elevations occurs. Depth to erodible sand limits cut depths for diversion alinement. Rough topography and steep slopes are factors to be considered in terrace and diversion alinement.

The degree and kind of limitations for sewage disposal systems are shown in table 7. Use of soils for sewage disposal is also affected by soil properties described in table 6. These include values for soil classification, permeability, and available water capacity. For filter fields, soil limitations are *slight*, *moderate*, or *severe*. *Slight* indicates good infiltration without contaminating the underground water; *moderate* indicates a finer grained soil that has a lower intake rate; *severe* indicates a high water table or an impervious soil.

Water must be retained in a sewage lagoon for aerobic decomposition of the fresh sewage to occur. Thus, an impervious soil is desirable for constructing a lagoon. The probability that a soil requires sealing with bentonite or sodium carbonate or lining with a commercial plastic or rubber liner is indicated. A lagoon constructed in sandy material where the water table is high would be the least desirable sewage disposal facility. A sewage filter field or disposal lagoon should be located where it will not contaminate wells that furnish domestic water supply or stockwater. Steepness of slope and the possibility of flooding are other factors to be considered in sewage treatment design.

Formation and Classification of the Soils

This section tells how the factors of soil formation have affected the formation of soils in Howard County. It also explains the system of soil classification currently

used and classifies each soil series according to that system.

Factors of Soil Formation

Soil is produced by soil-forming processes acting on materials deposited or accumulated by geologic agencies. The characteristics of the soil at any given point are determined by (1) the physical and mineralogical composition of the parent material, (2) the climate under which the soil material has accumulated and existed since accumulation, (3) the plant and animal life on and in the soil, (4) the relief, or lay of the land, and (5) the length of time the forces of soil formation have acted on the soil material.

Climate and plant and animal life, chiefly plants, are active factors of soil formation. They act on the parent material that has accumulated through the weathering of rocks and slowly change it to a natural body that has genetically related horizons. The effects of climate, plant, and animal life are conditioned by relief. The parent material also affects the kind of soil profile that is formed and, in extreme cases, determines it almost entirely. Finally, time is needed for changing the parent material into a soil profile. It may be much or little, but some time is always required for differentiation of soil horizons. Generally, a long time is required for the development of distinct horizons.

The factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made regarding the effect of any one factor unless conditions are specified for the other four. Many of the processes of soil development are unknown.

Parent material

Parent material is the unconsolidated mass from which a soil forms and is largely responsible for the chemical and mineralogical composition of the soil. Soils of this county developed in three different parent materials—loess, eolian sand, and alluvium.

Peoria Loess is the most extensive of the soil-forming materials in the county. This brownish- to yellowish-colored silt loam material ranges from a few feet to about 100 feet in thickness. Coly, Hastings, Holder, and Uly soils formed in Peoria Loess. They occupy uplands in the western and northern part of the county.

An older, reddish-colored loess underlies the Peoria Loess. This reddish material is exposed on the sides of some drainageways. Many of the exposed areas are less than 2 acres in size and are shown on the maps by spot symbols. Geary and Nuckolls soils formed in this reddish loess.

Eolian sand is the second most extensive soil-forming material in Howard County. Most of this windblown sandy material consists of quartz and feldspar minerals. It was blown from the Loup River Valleys and deposited in the southeastern section of the county. It is brownish-colored material and ranges in thickness from a few inches to around 100 feet. Valentine and Thurman soils formed in eolian sand. They are on stream terraces and uplands.

Alluvium is a mixture of clay, silt, sand, and gravel that was deposited by flood water. These deposits are generally more than 10 feet thick. Boel, Darr, Gibbon, Grigston, Inavale, Lamo, Ord, and Tryon soils formed in alluvium of the Loup River Valleys. Most of these bottom land soils are nearly level and very gently sloping. Hobbs soils are the most extensive alluvial soils along upland drainageways and creeks.

In many areas of the county, the soils formed in a combination of loess, eolian sand, and alluvium. Detroit, Hall, Hord, Kenesaw, Rusco, and Silver Creek soils formed in loess over alluvium. Most of these soils are on stream terraces, in river valleys, and along creeks in the southeastern part of the county. Elsmere and Simeon soils formed in eolian sand and sandy alluvium. They are on bottoms and stream terraces in the Middle Loup River Valley. Boelus, Libory, Loretto, O'Neill, and Ovina soils formed in a combination of all three parent materials. Most of these soils are on stream terraces in the Middle Loup River Valley in the southeastern part of the county.

Climate

Climate is an active factor in the formation of soils. Its influence is both direct and indirect. It affects the weathering and reworking of soil material directly through rainfall, temperature, and wind. It affects the soils indirectly through the amount and kind of vegetation and animal life sustained.

Howard County has a temperate, subhumid, and mid-continental climate that has a wide seasonal variation. Winter temperatures below 0°F. and summer temperatures higher than 95°F. are common. The average annual precipitation is about 24 inches, and the average annual temperature is about 50°F. Precipitation is heaviest during May and June and occurs during thunderstorms. Occasionally there are long periods of drought in August and September. Annual precipitation ranges from about 12 inches in dry years to about 40 inches in wet years. The average number of days without killing frost is 150 days. The growing season is generally from early in May until late in September or early in October. The ground is frozen for about 3 months of the year, and the frost penetrates to a depth of 4 feet during extremely cold periods. Wind velocities are high late in fall, in winter, and in spring.

The amount of rainfall in Howard County is not enough to leach the soils deeply, except the sandy soils. Most of the loamy soils in the county have calcium carbonate horizons that formed at a depth of 1 to 5 feet. Water movement through the soil has also carried clay particles from the surface layer to the subsoil. The depth to the calcium carbonate and the amount of clay in the subsoil have been modified by slope variations.

Wind influenced the formation of soils in this county. Many soils formed in loess material that was transported into the county by the wind. Most of the sandy soils in the southeastern part of the county formed from material blown from the Middle Loup River Valley. Windblown soil material is continually being mixed with the surface layer, causing minor changes in the physical and chemical properties of the soils.

Alternate freezing and thawing has some effect on soil formation. It tends to flocculate the soils into soil aggregates, depending upon the amount of moisture present. Biological activities are active in soil-forming processes, and they increase as the soil temperature increases.

Lack of rainfall has an indirect influence on soils. It prevents plant growth and leaves the soil unprotected and subject to soil blowing and water erosion.

Plant and animal life

Plant and animal life of various forms live on and in the soil and are active in the soil-forming processes. They provide the humus and affect the chemical and physical composition of the soil. The kinds of plants and animals present in the soil depend upon environmental factors, such as climate, parent material, age of soil, relief, and drainage. The influence of the climate is most apparent although not always the most important. It has an influence on the kinds and amount of vegetation that will grow on a given soil.

The native vegetation in Howard County is short, mid, and tall grasses in forested areas along the rivers and creeks. Most of the fibrous grass roots are in the upper part of the soil. They help to stabilize the soil and keep it open for water intake. Plant roots bring up minerals from the parent material, and the nutrients are returned to the surface as organic matter.

Organic matter is favorable for bacterial action, and the accumulation of it aids in the formation of good soil structure. Organic matter also affects the animal life and the color of the soil. The decay of organic matter over long periods gives the surface layer a dark color. Micro-organism activity increases with an increasing supply of organic matter on the well-drained soils.

The number and kinds of micro-organisms are important in soil formation. The undecomposed organic matter in the soil is food for the living organisms. These living organisms change the organic matter into humus from which plants can obtain nutrients for better growth.

The decay of organic matter is slow in wet areas because the living organisms are less numerous. Earthworms and small burrowing animals influence the formation of soils by mixing the organic and mineral parts of the soil.

Man has a great effect on plant and animal life by his management of the soil.

Relief

The relief in Howard County ranges from nearly level to very steep. Relief influences the formation of soils, mainly by controlling the movement of water on the surface. Relief, along with soil permeability, has much to do with surface runoff and internal drainge.

The more mature loamy upland soils are nearly level and very gently sloping. Runoff has been slow and most of the rainfall has been absorbed. Consequently, more leaching of soluble minerals and clay particles occurs, and more organic matter is produced because of the increase in vegetation. Thus, these soils have a well-developed profile.

Steep soils are not so well developed because runoff and erosion are greater. Less water has been absorbed by these soils, so soil formation is very slow. Water erosion removes soil as fast as it forms unless there is a good vegetative cover.

Soils that formed in similar parent material and under the same vegetation and climate, but that differ in relief can be grouped in sequences called catenas. Hastings, Holder, Uly, and Coly soils form such a catena in Howard County. The nearly level Hastings soils retain the greatest amount of moisture and have a well-developed profile. In contrast, the steep Coly soils retain the least moisture and have little or no profile development.

Relief is a factor in soil formation if it affects drainage. Poorly drained soils in depressions have a claypan subsoil because a large amount of clay has been leached into the subsoil. On bottom land, flooding and the need for drainage affect the rate of soil formation.

On sandy soils relief does not affect drainage, because permeability is rapid and there is little runoff. Moderately steep to steep sandy soils are generally more susceptible to soil blowing than the nearly level and gently sloping sandy soils. Soil formation on these soils is influenced more by the parent material and time than by relief.

Time

Time is required for soil formation. The amount of time needed for a well-developed profile to form depends on the influence of the other four soil-forming processes.

Some soils have been in place for only a short time. These young or immature soils have not had time to form distinct soil horizons. Examples of young soils in Howard County are the Hobbs soils on the bottom land and the Valentine soils on the sandy uplands and terraces. Steep loamy soils are immature also, because they are constantly losing soil material through erosion. Coly soils are an example of an immature steep soil.

Some soils in the county have been in place for a long period and are approaching an equilibrium with their environment. These soils are mature because they have distinct soil horizons. An example of a mature soil in Howard County is the nearly level Hastings soil. It formed in Peorian loess parent material that had been in place for a long time.

Classification of Soils

Classification consists of an orderly grouping of soils according to a system designed to make it easier to remember soil characteristics and interrelationships. Classification is useful in organizing and applying the results of experience and research. Soils are placed in narrow classes for discussion in detailed soil surveys and for application of knowledge to farms and fields. The many thousands of narrow classes are then grouped into progressively fewer and broader classes in successively higher categories, so that information can be applied to large geographic areas.

Two systems of classifying soils have been used in the United States in recent years. The older system was adopted in 1938 (*2*) and revised later (*8*). The system currently used by the National Cooperative Soil Survey was developed in the early sixties (*7*) and adopted in 1965 (*10*). It is under continual study.

The current system of classification has six categories. Beginning with the most inclusive, these categories are the order, the suborder, the great group, the subgroup, the family, and the series. The criteria for classification

are soil properties that are observable or measurable, but the properties are selected so that soils of similar genesis are grouped together. The placement of some soil series in the current system of classification, particularly in families, may change as more precise information becomes available.

Table 8 shows the classification of each soil series of Howard County by family, subgroup, and order, according to the current system, as of May, 1972.

Following are brief descriptions of each of the categories in the current system.

ORDER.—Ten soils orders are recognized. They are Entisols, Vertisols, Inceptisols, Aridisols, Mollisols, Spodosols, Alfisols, Ultisols, Oxisols, and Histosols. The properties used to differentiate these soil orders are those that tend to give broad climatic groupings of soils. The two exceptions to this are the Entisols and Histosols, which occur in many different kinds of climate. Table 8 shows the two soil orders in Howard County—Entisols and Mollisols.

Entisols are light-colored, mineral soils that have little, if any, horizon development. The soil material has not been mixed by shrinking and swelling.

Mollisols are mineral soils that formed under grass. They have a thick, dark-colored surface layer dominated by bivalent cations, a moderate to strong structure, and a base saturation of more than 50 percent. The soil material has not been mixed by shrinking and swelling.

SUBORDER.—Each order is divided into suborders, primarily on the basis of soil characteristics that produce classes having genetic similarity. A suborder has a narrower climatic range than an order. The criteria for suborders reflect either the presence or absence of waterlogging or differences in climate or vegetation.

GREAT GROUP.—Each suborder is divided into great groups on the basis of uniformity in the kind and sequence of genetic horizons.

SUBGROUP.—Each great group is divided into subgroups, one representing the central, or typic, segment of the group, and others called intergrades, that have mostly properties of one great group and also one or more properties of another great group.

FAMILY.—Families are established within each subgroup, primarily on the basis of properties important to plant growth. Among these properties are texture, mineralogy, reaction, soil temperature, permeability, thickness of horizons, and consistence.

SERIES.—The series has the narrowest range of characteristics of the categories in the classification system. It is explained in the section "How This Survey Was Made." A detailed description of each soil series in the county is given in the section "Descriptions of the Soils."

TABLE 8.—*Soil series classified according to the current system of classification*

Series	Family	Subgroup	Order
Boel	Sandy, mixed, mesic	Aquic Haplustolls	Mollisols.
Boelus	Sandy over loamy, mixed, mesic	Udic Haplustolls	Mollisols.
Coly	Fine-silty, mixed (calcareous) mesic	Typic Ustorthents	Entisols.
Darr	Coarse-loamy, mixed, mesic	Fluventic Haplustolls	Mollisols.
Detroit	Fine, montmorillonitic, mesic	Pachic Argiustolls	Mollisols.
Elsmere	Sandy, mixed, mesic	Aquic Haplustolls	Mollisols.
Geary [1]	Fine-silty, mixed, mesic	Udic Argiustolls	Mollisols.
Gibbon	Fine-silty, mixed (calcareous) mesic	Typic Haplaquolls	Mollisols.
Grigston	Fine-silty, mixed, mesic	Fluventic Haplustolls	Mollisols.
Hall	Fine-silty, mixed, mesic	Pachic Argiustolls	Mollisols.
Hastings	Fine, montmorillonitic, mesic	Udic Argiustolls	Mollisols.
Hobbs	Fine-silty, mixed, mesic	Cumulic Haplustolls	Mollisols.
Holder [2]	Fine-silty, mixed, mesic	Udic Argiustolls	Mollisols.
Hord	Fine-silty, mixed, mesic	Pachic Haplustolls	Mollisols.
Inavale	Mixed, mesic	Typic Ustipsamments	Entisols.
Kenesaw	Coarse-silty, mixed, mesic	Typic Haplustolls	Mollisols.
Lamo	Fine-silty, mixed (calcareous) mesic	Cumulic Haplaquolls	Mollisols.
Libory	Sandy over loamy, mixed, mesic	Udic Haplustolls	Mollisols.
Loretto	Fine-loamy, mixed, mesic	Udic Haplustolls	Mollisols.
Nuckolls [3]	Fine-silty, mixed, mesic	Typic Haplustolls	Mollisols.
O'Neill	Coarse-loamy, mixed, mesic	Typic Haplustolls	Mollisols.
Ord	Coarse-loamy, mixed, mesic	Fluvaquentic Haplustolls	Mollisols.
Ortello	Coarse-loamy, mixed, mesic	Udic Haplustolls	Mollisols.
Ovina	Coarse-loamy, mixed, mesic	Aquic Haplustolls	Mollisols.
Rusco	Fine-silty, mixed, mesic	Aquic Argiustolls	Mollisols.
Silver Creek	Fine, mixed (calcareous) mesic	Typic Haplaquolls	Mollisols.
Simeon	Mixed, mesic	Typic Ustipsamments	Entisols.
Thurman	Sandy, mixed, mesic	Udorthentic Haplustolls	Mollisols.
Tryon	Mixed, mesic	Typic Psammaquents	Entisols.
Uly	Fine-silty, mixed, mesic	Typic Haplustolls	Mollisols.
Valentine	Mixed, mesic	Typic Ustipsamments	Entisols.

[1] The Geary soils in Howard County are taxadjuncts to the Geary series. They have a thinner, lighter colored A horizon than is defined in the range for the series.

[2] The severely eroded Holder soil in mapping unit HpC3 is a taxadjunct to the Holder series. It has a thinner, lighter colored A horizon than is defined in the range for the series.

[3] The severely eroded Nuckolls soil in the mapping unit NsD3 is a taxadjunct to the Nuckolls series. It has a thinner, lighter colored A horizon than is defined in the range for the series.

General Nature of the County

This section provides general information about the physiography, relief, and drainage. It also gives facts about the climate, settlement and population, transportation, industry and markets, and farming. The statistics used are mainly from reports of the United States Bureau of the Census.

Physiography, Relief, and Drainage

During the Tertiary period, the Ogallala Formation was deposited over central Nebraska. This formation consists of limestone, siltstone, and sandstone alternating with unconsolidated beds of gravel, sand, silt, and clay. Most of the Ogallala Formation is cemented by lime and capped by impure limestone. Small areas of this formation are exposed in the deep drainageways in the northern part of the county and along the bottom of the upland breaks bordering the North Loup River Valley.

In the area south and east of the Middle Loup River, a more recent basal deposit overlies the Ogallala Formation. During the Pleistocene period, the Grand Island and Holdrege Formation was deposited over the Ogallala Formation. The basal deposit of sand and gravel consists mainly of quartz and feldspar containing minor quantities of mica. The gravel has weathered from a variety of rocks, principally those of igneous origin. Thin beds of silt and clay occur in the Grand Island and Holdredge deposits.

Recent deposits of loess, alluvium, and eolian sand have been deposited over the Howard County landscape. These deposits have covered the Ogallala Formation and the Grand Island and Holdrege Formations. The soils of Howard County formed in these recent deposits.

Howard County is divided into three general physiographic areas: (1) sandy to loamy soils of the bottom land along the Loup Rivers; (2) loamy soils of the uplands and stream terraces north and west of the Middle Loup River; and (3) sandy to loamy soils on the old stream terraces south and east of the Middle Loup River.

The sandy to loamy soils of the bottom land along the Loup Rivers formed in recent alluvium. These alluvial deposits are a mixture of clay, silt, sand, and gravel. Some have been reworked somewhat by wind. Many of the soils on lower bottoms are somewhat poorly drained to poorly drained and subject to some flooding. On the higher bottoms they are seldom flooded, and the static water level is below a depth of 6 feet. Beneath these recent alluvial deposits are either the Grand Island and Holdrege Formations or the Ogallala Formation. The relief of this area is nearly level to gently sloping, and all of the drainage is directly into one of the Loup Rivers.

All three Loup Rivers of Nebraska join into one Loup River in Howard County. The South Loup River joins the Middle Loup River in the Southwestern corner. The Middle Loup River angles across the county from southwest to northeast until it meets the North Loup River northeast of St. Paul. The North Loup River enters the county in the northwestern corner and flows in a southeasterly direction until it joins the Middle Loup River. The Loup River leaves the county approximately 10 miles northeast of St. Paul. Most of the county is drained by these rivers.

The loamy soils of the uplands and stream terraces north and west of the Middle Loup River formed in thick deposits of Peoria Loess (*3*). These loess deposits are brownish to yellowish in color and range to as much as 100 feet in thickness. They generally range from 40 to 50 feet in the northern part of the county and from 20 to 30 feet in the southwestern part. The higher stream terraces are covered with loess deposits that generally are less than 10 feet thick. Beneath the Peoria Loess deposits and above the Ogallala bedrock, lies the reddish-colored Loveland Loess. These loamy loess deposits range from a few feet to about 100 feet in thickness and appear on some of the slopes along drainageways. The relief of this area ranges from nearly level to steep. All of the drainage is directly or indirectly into the Loup Rivers.

The sandy to loamy soils on the old stream terraces south and east of the Middle Loup River formed in alluvium, loess, and eolian sand. This area consists of alluvial deposits that overlie the Grand Island and Holdrege Formation. These recent alluvial deposits are a mixture of clay, silt, sand, and gravel that have been deposited by the Loup Rivers and the Platte River. Most of these deposits have been covered by eolian sand and loess of a more recent age. The eolian sand deposits are from old alluvial sand deposits that have been reworked by wind and blown into hummocks or hills. These sand deposits range from a few inches to as much as 100 feet in thickness. The size and height of the hummocks tend to decrease as one travels south and east from the Middle Loup River Valley. Small areas of light-colored loess cover the alluvial deposits in some areas. The relief in this area ranges from nearly level to strongly sloping. Much of the drainage is directly or indirectly into the Middle Loup River. The southeastern part of the county drains indirectly into the Platte River.

In general, the county is well drained. The general slope of the county is to the south and east. Elevation ranges from 2,140 feet in the northwestern corner to 1,740 feet where the Loup River crosses the eastern boundary (*4*). The average elevation of the uplands is 2,000 feet and of the river valleys, 1,820 feet.

The dominant direction of the underground water movement is south and east. The static water level ranges from a depth of about 200 feet in the northern part of the county to the surface along the rivers. The Grand Island and Holdrege basal deposit is the best water-holding formation in the county. Many good irrigation wells have been drilled in this formation, and the water level is being lowered as the number of wells increases.

Climate [7]

Howard County is in central Nebraska, near the center of the United States. The climate is typical of the interior of large continents in middle latitudes. Such climates are characterized by moderate rainfall, cold win-

[7] Prepared by RICHARD E. MYERS, State climatologist, ESSA, National Weather Service.

ters, and warm summers with frequent and rather large changes in the weather, both day to day and season to season.

The weather in Howard County is largely determined by air masses from four source regions. Cool, dry periods are common when the air mass over the county has its origin in the Northern Pacific. Air from the Canadian interior brings, cold, dry conditions. Most of the precipitation is carried in by warm winds from the Gulf of Mexico. At times air from the desert to the southwest moves in and brings very hot, dry periods. Many of the stormy periods are associated with the transition from one type of air mass to another.

As a rule, more than three-fourths of the annual precipitation falls during the period April through September. This period is most important to farming because it covers the major part of the active growing season. Precipitation early in spring is of a slow, steady type and is well distributed. As spring advances, more and more of the rainfall occurs during erratic thundershowers, and by the latter part of May nearly all of the precipitation comes in this manner. Rainfall may be heavy in one locality, and light in a spot nearby. Local drought conditions develop when the showers are poorly spaced in time or area.

Thunderstorms in spring and early in summer are severe at times and may be accompanied by local downpours, hail, and damaging winds or an occasional tornado. An inch of rain falls in 30 minutes an average of once per year, and nearly 2 inches will fall in 30 minutes about once in 10 years. The hailstorms that sometimes occur in connection with the downpours generally are local in extent, of short duration, and produce damage in an extremely variable and spotted pattern.

The intensity and frequency of the showers decrease later in summer, and as fall progresses, they become lighter and less frequent. Table 9 shows that the average monthly precipitation decreases from 3.3 inches in July, to 2.5 inches in August, and to 1 inch in October. The drier weather in fall, combined with an abundance of sunshine, is favorable to the maturing crops and aids in their harvest.

Precipitation is generally light in winter and is about evenly distributed. Although nearly all of the precipitation in winter falls as snow, it is not unusual to have one or more freezing rains that leave a glaze of ice over all exposed objects. The snow is often accompanied by strong, northerly winds and rapidly falling temperatures, and it often accumulates in huge drifts before the wind subsides.

The prevailing wind is southerly from May through October and north-northwesterly the rest of the year. The yearly average windspeed is about 12 to 13 miles per hour. March and April are the windiest months. Average windspeed in these months is more than 14 miles per hour. Most of the persistently high winds are associated with intense, deep, low-pressure systems that develop infrequently. In summer the high winds accompany thundershowers.

The frequency of high and low temperatures is indicated in table 9. For example, the data show that in 1 year of every 5 at least 4 days in July have temperatures

TABLE 9.—*Temperature and precipitation in Howard County, Nebr.*

[All data from St. Paul, Nebr.]

Month	Temperature				Precipitation				
	Average daily maximum [1]	Average daily minimum [1]	Two years in 10 will have at least 4 days with— Maximum temperature equal to or higher than [2]	Two years in 10 will have at least 4 days with— Minimum temperature equal to or lower than [1]	Average total [1]	One year in 10 will have— Equal to or less than [3]	One year in 10 will have— Equal to or more than [3]	Days with snow cover of 1 inch or more [1]	Average depth of snow on days with snow cover [1]
	° F.	° F.	° F.	° F.	In.	In.	In.	No.	In.
January	35	11	55	−11	0.4	([4])	1.1	14	5
February	39	16	61	−5	.7	.1	1.2	13	4
March	48	24	72	5	1.2	.2	2.2	7	5
April	64	37	82	23	2.3	.6	4.6	1	2
May	75	49	89	34	3.8	1.3	6.9	([5])	2
June	83	59	98	47	4.8	1.8	8.0	0	0
July	90	64	103	54	3.3	.9	6.9	0	0
August	89	62	100	52	2.5	1.1	5.4	0	0
September	79	52	96	37	2.4	.5	5.2	0	0
October	70	40	85	26	1.0	.1	3.3	0	0
November	51	25	70	10	.5	([4])	2.0	2	3
December	40	16	58	−3	.6	([4])	1.4	9	4
Year	64	38	[6] 104	[7] −18	23.5	16.5	30.8	45	4

[1] Based on 1937–66 data.
[2] Based on 1931–63 data.
[3] Based on 1895–1966 data.
[4] Trace.
[5] Less than half a day.
[6] Average annual maximum.
[7] Average annual minimum.

of 103°F. or higher, and the average annual high is 104°. The table also shows that in 1 year of 5, in the month of January, the temperature falls to −11°F. or lower on 4 nights, and the average annual minimum is −18°. A high temperature of 115°F. was recorded in 1936, and a low of −33° was recorded in 1963. The probabilities of freezing temperatures by certain specified dates are shown in table 10.

Annual free-water evaporation from shallow lakes averages about 44 inches, and approximately 76 percent occurs during the 6-month period May through October.

Farming

From the date of its earliest settlement, Howard County has been a farming area. The land was broken from its prairie sod and planted to wheat, corn, barley, oats, and potatoes (6).

The number of farms in the county increased during the period from 1871 to about 1920. As tractors and new machinery replaced the horse, the number of farms began to decrease. Today, mechanization enables one man to farm more land, and the size of the farm is increasing. The United States Census of Agriculture shows that in 1954 there were 1,201 farms in Howard County, and the average size of a farm was 281 acres. In 1968 there were 920 farms and the average size was 393 acres. The number of farms operated by owners has decreased since the early settlement. Today over half the farm operators are tenants or part owners. The number of farm tenants reached a peak in the forties and early fifties, but it has decreased since that period because the size of farms has increased.

The type of farming has changed through the years as new markets and demands developed. Many crops declined in acreage, and acreage planted to new types and varieties of grain and feed crops increased. Some of the crops that have shown a general decline in acreage since the early settlement are potatoes, barley, rye, and oats. Today the main crops are corn, sorghum, wheat, and alfalfa. The United States Census of Agriculture shows that in 1954 corn was planted on 76,623 acres; in 1959 it was planted on 62,885 acres; and in 1968 it was planted on 62,490 acres.

In 1954 sorghum was planted on 2,927 acres; in 1959 it was planted on 13,623 acres; and in 1968 it was planted on 11,480 acres. In 1954 wheat was harvested on 12,765 acres; in 1959 it was harvested on 20,089 acres; and in 1968 it was harvested on 10,800 acres. In 1954 alfalfa hay was harvested on 29,873 acres; in 1959 it was harvested on 22,085 acres; and in 1968 it was harvested on 24,000 acres.

The use of commercial fertilizer and other fertilizing material has shown a steady increase since the late forties. In 1954 commercial fertilizer was used on 18,934 acres, but by 1968 it was used on 85,900 acres. In 1968, 8,790 tons of commercial fertilizer was used in the county, and over half of this amount was applied to cornfields. Nitrogen and phosphorus are the main fertilizers used in Howard County, and lime is the main soil amendment used.

The number of acres irrigated in Howard County has increased greatly since the early fifties. In 1954 there were only 5,098 acres of irrigated farmland, but by 1968 there were 59,000 acres. Pump irrigation is the most extensive in the river valleys and in the southeastern part of the county. In 1969 there were over 350 irrigation wells in the county. The best wells are in the southeastern part of the county because they are over the best underground water-bearing formation. Most of the wells in this area pump at the rate of 1,000 gallons or more per minute. The area of upland flats surrounding the town of Farwell and south to the Middle Loup River has also been brought under irrigation. The Farwell Irrigation Project brought these table lands under irrigation in the period from 1963 to 1967. In this area the water is obtained through diversion canals.

Corn, sorghum, and alfalfa are the main irrigated crops. Gravity irrigation is the system most commonly used in Howard County.

TABLE 10.—*Probabilities of last freezing temperatures in spring and first in fall in Howard County, Nebr.*

[All data from St. Paul, Nebr.]

Probability	Dates for given probability and temperature [1]				
	16°F. or lower	20°F. or lower	24°F. or lower	28°F. or lower	32°F. or lower
Spring:					
1 year in 10 later than	April 10	April 15	April 26	May 10	May 20
2 years in 10 later than	April 4	April 9	April 21	May 4	May 15
5 years in 10 later than	March 25	March 30	April 11	April 24	May 5
Fall:					
1 year in 10 earlier than	October 25	October 19	October 10	September 28	September 20
2 years in 10 earlier than	October 31	October 24	October 15	October 4	September 25
5 years in 10 earlier than	November 10	November 3	October 25	October 16	October 4

[1] All freeze data are based on temperatures in a standard National Weather Service thermometer shelter at a height of approximately 5 feet above the ground and in a representative exposure. Lower temperatures will exist at times nearer the ground and in local areas subject to extreme air drainage.

The first herd of cattle was brought to the county in 1871. Livestock has become a major source of income to the farmers of Howard County. Much of the feed-grain crops and hay are fed to beef cattle and hogs in feedlots. Most of the farm operators grow grain and hay in summer while the cattle are in pasture. In winter the beef cattle and hogs are fattened with the grain and hay produced during the summer. Sheep, chickens, dairy cattle and a few horses are also raised in the county. The United States Census of Agriculture shows that in 1954 there were 47,462 cattle and calves in the county, and in 1964 there were 59,589. Also, in 1954 there were 29,651 hogs 1,352 sheep; and 156,890 chickens 4 months old or more. In 1964 there were 38,293 hogs; 1,447 sheep; and 87,410 chickens 4 months old or more.

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Glossary

Alluvium. Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

Available water capacity. The capacity of a soil to hold water available for use by plants, usually expressed in linear depths of water per unit depth of soil. Commonly defined as the difference between the percentage of soil water at field capacity and the percentage at wilting point. This difference multiplied by the bulk density and divided by 100 gives a value in inches of water per inch of soil. In this survey, the classes of available water capacity for a soil 60 inches deep, or to a limiting layer are:

Inches	
0 to 3	Very low
3 to 6	Low
6 to 9	Moderate
More than 9	High

Buried soil. A developed soil, once exposed but now overlain by more recently formed soil.

Calcareous soil. A soil containing enough calcium carbonate (often with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid.

Catsteps. Narrow steps on moderately steep and steep hillsides, caused by slumping or soil slippage.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Claypan. A compact, slowly permeable soil horizon that contains more clay than the horizon above and below it. A claypan is commonly hard when dry and plastic or stiff when wet.

Colluvium. Soil material, rock fragments, or both, moved by creep, slide, or local wash and deposited at the base of steep slopes.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrations of compounds, or of soil grains cemented together. The composition of some concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are examples of material commonly found in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material, and tends to stretch somewhat and pull apart, rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard and brittle; little affected by moistening.

Contour stripcropping. Growing crops in strips that follow the contour or are parallel to terraces or diversions. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Dispersion, soil. Deflocculation of the soil and its suspension in water.

Drainage class (natural). Refers to the conditions of frequency and duration of periods of saturation or partial saturation that existed during the development of the soil, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven different classes of natural soil drainage are recognized.

Excessively drained soils are commonly very porous and rapidly permeable and have a low water-holding capacity.

Somewhat excessively drained soils are also very permeable and are free from mottling throughout their profile.

Well-drained soils are nearly free from mottling and are commonly of intermediate texture.

Moderately well drained soils commonly have a slowly permeable layer in or immediately beneath the solum. They have uniform color in the A and upper B horizons and have mottling in the lower B and the C horizons.

Somewhat poorly drained soils are wet for significant periods but not all the time, and some soils commonly have mottling at a depth below 6 to 16 inches.

Poorly drained soils are wet for long periods and are light gray and generally mottled from the surface downward, although mottling may be absent or nearly so in some soils.

Very poorly drained soils are wet nearly all the time. They have a dark-gray or black surface layer and are gray or light gray, with or without mottling, in the deeper parts of the profile.

Dune. A mound or ridge of loose sand piled up by the wind.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by wind (sandblast), running water, and other geological agents.

Fertility, soil. The quality of a soil that enables it to provide compounds, in adequate amounts and in proper balance, for the growth of specified plants, when other growth factors such as light, moisture, temperature, and the physical condition of the soil are favorable.

Genesis, soil. The manner in which a soil originates. Refers especially to the processes initiated by climate and organisms that are responsible for the development of the solum, or true soil, from the unconsolidated parent material, as conditioned by relief and age of landform.

Horizon, soil. A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes. These are the major horizons:

O horizon.—The layer of organic matter on the surface of a mineral soil. This layer consists of decaying plant residues.

A horizon.—The mineral horizon at the surface or just below an O horizon. This horizon is the one in which living organisms are most active and therefore is marked by the accumulation of humus. The horizon may have lost one or more of soluble salts, clay, and sesquioxides (iron and aluminum oxides).

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or some combination of these; (2) by prismatic or blocky structure; (3) by redder or stronger colors than the A horizon; or (4) by some combination of these. Combined A and B horizons are usually called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.—The weathered rock material immediately beneath the solum. In most soils this material is presumed to be like that from which the overlying horizons were formed. If the material is known to be different from that in the solum, a Roman numeral precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock usually underlies a C horizon but may be immediately beneath an A or B horizon.

Leaching. The removal of soluble materials from soils or other material by percolating water.

Lime. Chemically, lime is calcium oxide (CaO), but its meaning has been extended to include all limestone-derived materials applied to neutralize acid soils. Agricultural lime can be obtained as ground limestone, hydrated lime, or burned lime, with or without magnesium minerals. Basic slag, oystershells, and marl also contain calcium.

Loess. Fine-grained material, dominantly of silt-sized particles, that has been deposited by wind.

Mottling, soil. Irregularly marked with spots of different colors that vary in number and size. Mottling in soils usually indicates poor aeration and lack of drainage. Descriptive terms are as follows: Abundance—*few, common,* and *many;* size—*fine, medium,* and *coarse;* and contrast—*faint, distinct,* and *prominent.* The size measurements are these: *fine,* less than 5 millimeters (about 0.2 inch) in diameter along the greatest dimension; *medium,* ranging from 5 millimeters to 15 millimeters (about 0.2 to 0.6 inch) in diameter along the greatest dimension; and *coarse,* more than 15 millimeters (about 0.6 inch) in diameter along the greatest dimension.

Munsell notation. A system for designating color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with a hue of 10YR, a value of 6, and a chroma of 4.

Permeability. The quality that enables the soil to transmit air and water. In this survey, terms used to describe permeability apply to that part of the soil below the Ap or equivalent layer and above a depth of 60 inches, or to bedrock. Where there is a change of two or more permeability classes within a short vertical distance, the classes and depths are stated. Classes of soil permeability are:

Inches per hour	
Less than 0.063	Very slow
0.063 to 0.20	Slow
0.20 to 0.63	Moderately slow
0.63 to 2.00	Moderate
2.00 to 6.30	Moderately rapid
6.30 to 20.00	Rapid
20.00 and higher	Very rapid

Profile soil. A vertical section of the soil through all its horizons and extending into the parent material.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. An acid, or "sour," soil is one that gives an acid reaction; an alkaline soil is one that is alkaline in reaction. In words, the degrees of acidity or alkalinity are expressed thus:

	pH		*pH*
Extremely acid	Below 4.5	Neutral	6.6 to 7.3
Very strongly acid	4.5 to 5.0	Mildly alkaline	7.4 to 7.8
Strongly acid	5.1 to 5.5	Moderately alkaline	7.9 to 8.4
Medium acid	5.6 to 6.0	Strongly alkaline	8.5 to 9.0
Slightly acid	6.1 to 6.5	Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Runoff, surface. The water that flows off the land surface without sinking in.

Saline-alkali soil. A soil that contains a harmful concentration of salts and exchangeable sodium; or contains harmful salts and has a highly alkaline reaction; or contains harmful salts and exchangeable sodium and is strongly alkaline. The salts, exchangeable sodium, and alkaline reaction occur in the soil in such location that growth of most crop plants is less than normal.

Sand. Individual rock or mineral fragments in a soil that range in diameter from 0.05 to 2.0 millimeters. Most sand grains consist of quartz, but they may be of any mineral composition. The textural class name of any soil that contains 85 percent or more sand and not more than 10 percent clay.

Silt. Individual mineral particles in a soil that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). Soil of the silt textural class is 80 percent or more silt and less than 12 percent clay.

Slope, soil. The degree of deviation of a surface from the horizontal, usually expressed in percent or degrees. In this survey, the following slope classes are used:

Percent	
0 to 1	Nearly level
1 to 3	Very gently sloping
3 to 5	Gently sloping or gently rolling
5 to 11	Moderately sloping
11 to 15	Strongly sloping or rolling
15 to 31	Steep
31 to 65	Very steep

Soil. A natural, three-dimensional body on the earth's surface that supports plants and that has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Stratified. Composed of, or arranged in, strata, or layers, such as stratified alluvium. The term is confined to geological material. Layers in soils that result from the processes of soil formation are called horizons; those inherited from the parent material are called strata.

Stripcropping. Growing crops in a systematic arrangement of strips, or bands, to serve as vegetative barriers to wind and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are—*platy* (laminated), *pris-*

matic (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

Subsoil. In this survey, the B horizon of a soil; generally, the part of the solum below plow depth.

Surface soil. In this survey, the A horizon of the soil; generally, the layer at the surface, regardless of its thickness.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that it may soak into the soil or flow slowly to a prepared outlet without harm. Terraces in fields are generally built so they can be farmed. Terraces intended mainly for drainage have a deep channel that is maintained in permanent sod.

Terrace (geological). An old alluvial plain, ordinarily flat or undulating, bordering a river, lake, or the sea. Stream terraces are frequently called second bottoms, as contrasted to flood plains, and are seldom subject to overflow. Marine terraces were deposited by the sea and are generally wide.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay*, and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Tilth, soil. The condition of the soil in relation to the growth of plants, especially soil structure. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable, granular structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

Water table. The highest part of the soil or underlying rock material that is wholly saturated with water. In some places an upper, or perched, water table may be separated from a lower one by a dry zone.

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U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
UNIVERSITY OF NEBRASKA, CONSERVATION AND SURVEY DIVISION

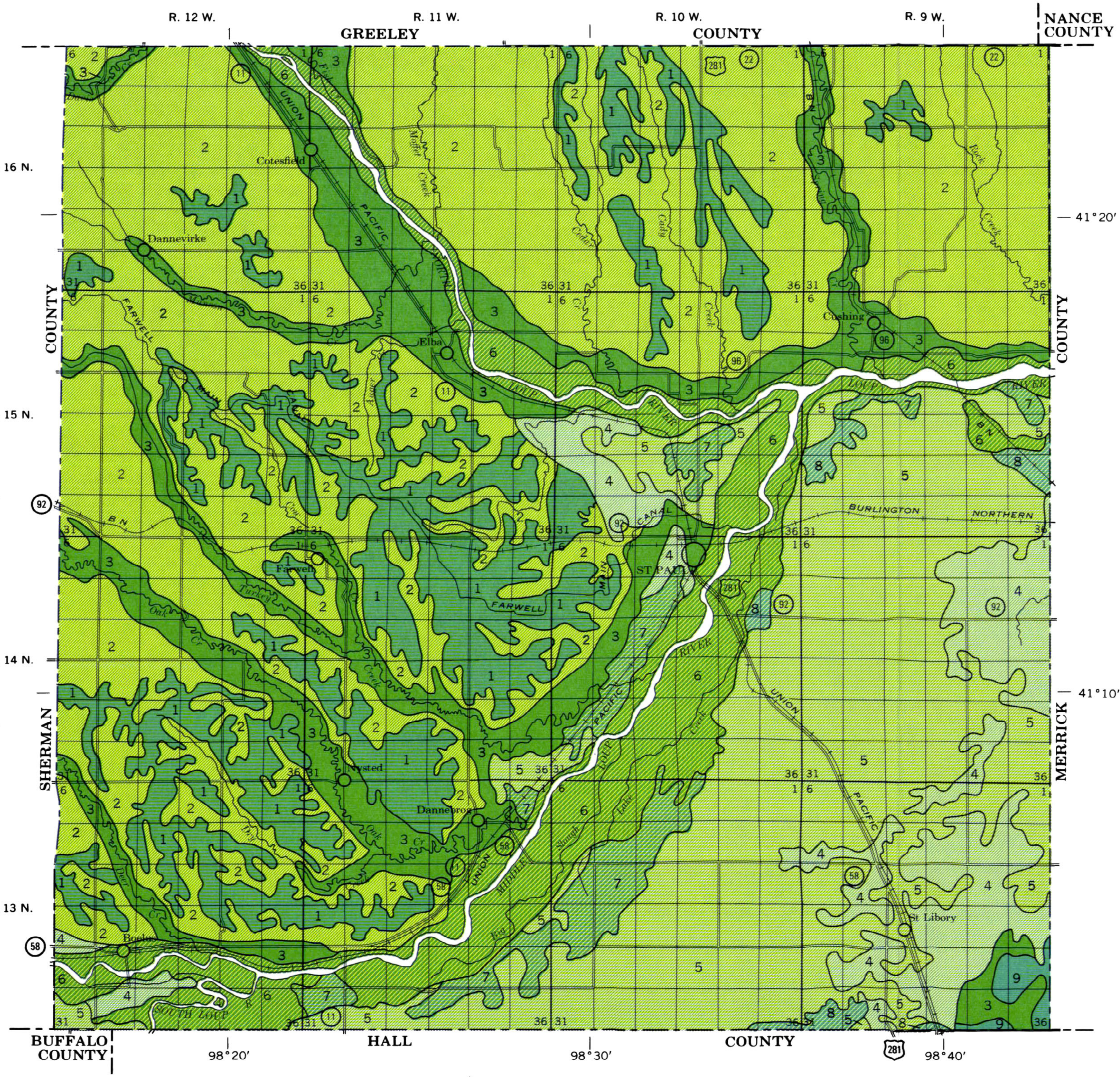
GENERAL SOIL MAP

HOWARD COUNTY, NEBRASKA

Scale 1:190,080

1 0 1 2 3 4 Miles

N



SOIL ASSOCIATIONS*

1. Holder–Hastings association: Deep, nearly level to gently sloping, silty soils on uplands
2. Coly–Holder–Uly association: Deep, sloping to steep, silty soils on uplands
3. Hord–Hobbs association: Deep, nearly level to genlty sloping, silty soils on stream terraces and bottom lands
4. Kenesaw–Ortello–Libory association: Deep, nearly level to sloping, loamy and sandy soils on stream terraces and uplands
5. Valentine–Thurman–Libory association: Deep, nearly level to strongly sloping, sandy soils on uplands and stream terraces
6. Inavale–Boel–Tryon association: Deep, nearly level to gently sloping, sandy and silty soils on bottom lands of the Loup River Valleys
7. Simeon–O'Neill association: Nearly level to gently sloping, sandy and loamy soils, on stream terraces, that are shallow to moderately deep over sand and gravel
8. Tryon–Elsmere–Gibbon association: Deep, nearly level to very gently sloping, sandy and silty soils on stream terraces and bottom lands
9. Silver Creek–Slickspots association: Deep, nearly level to very gently sloping, saline and alkali soils, on stream terraces, that have a silty surface layer and a clayey subsoil

*Texture refers to surface layer of major soils in each association unless otherwise stated

Compiled 1972

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.

SOIL LEGEND

Each soil symbol consists of letters, or of letters and numbers; for example, B, HgB2, or 2ThA. If slope is given in the soil name and is more than 1 percent, the last capital letter, A, B, C, or D, in a symbol shows the slope class. A final number, 2 or 3, in the symbol shows that the soil is eroded or severely eroded.

SYMBOL	NAME
B	Blown-out land
Boa	Boel loamy fine sand
Bob	Boel fine sandy loam
Boc	Boel loam
CbC	Coly silt loam, 5 to 11 percent slopes
CbD	Coly silt loam, 11 to 31 percent slopes
CUD	Coly-Uly complex, 15 to 31 percent slopes
Da	Darr fine sandy loam
Db	Darr silt loam
De	Detroit silt loam, 0 to 1 percent slopes
Ea	Elsmere loamy fine sand
Gg	Gibbon silt loam
Gk	Grigston silt loam
GsC3	Geary soils, 7 to 11 percent slopes, severely eroded
GsD3	Geary soils, 11 to 15 percent slopes, severely eroded
Ha	Hall silt loam, 0 to 1 percent slopes
2Hb	Hobbs silt loam, occasionally flooded
Hb	Hobbs silt loam, 0 to 1 percent slopes
HbA	Hobbs silt loam, 1 to 3 percent slopes
HbB	Hobbs silt loam, 3 to 5 percent slopes
Hd	Hord silt loam, 0 to 1 percent slopes
Hg	Holder silt loam, 0 to 1 percent slopes
HgA	Holder silt loam, 1 to 3 percent slopes
HgB2	Holder silt loam, 3 to 5 percent slopes, eroded
HgC	Holder silt loam, 5 to 11 percent slopes
HpC2	Holder silty clay loam, 5 to 11 percent slopes, eroded
HpC3	Holder silty clay loam, 5 to 11 percent slopes, severely eroded
Hs	Hastings silt loam, 0 to 1 percent slopes
Ia	Inavale loam
If	Inavale fine sand
Ig	Inavale loamy fine sand
In	Inavale fine sandy loam
Ks	Kenesaw silt loam, 0 to 1 percent slopes
KsB	Kenesaw silt loam, 1 to 5 percent slopes
KsC	Kenesaw silt loam, 5 to 11 percent slopes
KSz	Kenesaw-Slickspots complex

SYMBOL	NAME
L	Loretto complex, 0 to 5 percent slopes
La	Lamo silt loam
LB	Libory-Boelus fine sands
LC	Libory-Boelus loamy fine sands
M	Marsh
NsD3	Nuckolls soils, 15 to 31 percent slopes, severely eroded
Oa	Ovina loamy fine sand
ObB	Ortello loamy fine sand, 1 to 5 percent slopes
Oe	Ord loam
Of	Ord fine sandy loam
Ok	O'Neill loam, 0 to 3 percent slopes
OrA	Ortello fine sandy loam, 0 to 1 percent slopes
Ot	Ortello loam, 0 to 1 percent slopes
OtB	Ortello loam, 1 to 5 percent slopes
OxD	Ortello-Coly complex, 15 to 31 percent slopes
RB	Rough broken land, loess
Ru	Rusco silt loam
Sm	Simeon loamy sand, 0 to 3 percent slopes
SS	Silver Creek-Slickspots complex
Sy	Silty alluvial land
TfB	Thurman fine sand, 0 to 5 percent slopes
ThA	Thurman loamy fine sand, 0 to 3 percent slopes
ThB	Thurman loamy fine sand, 3 to 5 percent slopes
2ThA	Thurman loamy fine sand, loamy substratum, 0 to 3 percent slopes
2To	Tryon soils, drained
Ty	Tryon loam
UsC	Uly silt loam, 5 to 11 percent slopes
UsD	Uly silt loam, 11 to 15 percent slopes
VaC	Valentine fine sand, rolling
VTD	Valentine and Thurman soils, 0 to 17 percent slopes

CONVENTIONAL SIGNS

WORKS AND STRUCTURES

Highways and roads
- Divided
- Good motor
- Poor motor
- Trail

Highway markers
- National Interstate
- U. S.
- State or county

Railroads
- Single track
- Multiple track
- Abandoned

Bridges and crossings
- Road
- Trail
- Railroad
- Ferry — FY
- Ford — FORD
- Grade
- R. R. over
- R. R. under

Buildings
- School
- Church

Mine and quarry

Gravel pit

Power line

Pipeline

Cemetery

Dams

Levee

Tanks

Well, oil or gas

Forest fire or lookout station

Windmill

Located object

BOUNDARIES

National or state

County

Minor civil division

Reservation

Land grant

Small park, cemetery, airport

Land survey division corners

DRAINAGE

Streams, double-line
- Perennial
- Intermittent

Streams, single-line
- Perennial
- Intermittent
  - Crossable with tillage implements
  - Not crossable with tillage implements
  - Unclassified

Canals and ditches

Lakes and ponds
- Perennial — water, w
- Intermittent — int

Spring

Well, irrigation

Wet spot

Drainage end or alluvial fan

RELIEF

Escarpments
- Bedrock
- Other

Short steep slope

Prominent peak

Depressions (Large, Small)
- Crossable with tillage implements
- Not crossable with tillage implements
- Contains water most of the time

SOIL SURVEY DATA

Soil boundary and symbol — Dx

Gravel

Stoniness
- Stony
- Very stony

Rock outcrops

Chert fragments

Silt and clay spot

Sand spot

Gumbo or scabby spot

Made land

Severely eroded spot

Blowout, wind erosion

Gully

Saline or alkali spot

GUIDE TO MAPPING UNITS

For a full description of a mapping unit, read both the description of the mapping unit and that of the soil series to which the mapping unit belongs. For complete information about a capability unit, read both the introduction to "Management of Soils for Crops" and the description of the capability unit in this section. For general information about the use of the soils for windbreaks and as wildlife habitat, refer to the sections "Management of Soils for Windbreaks" and "Management of Soils for Wildlife." Other information is given in tables as follows:

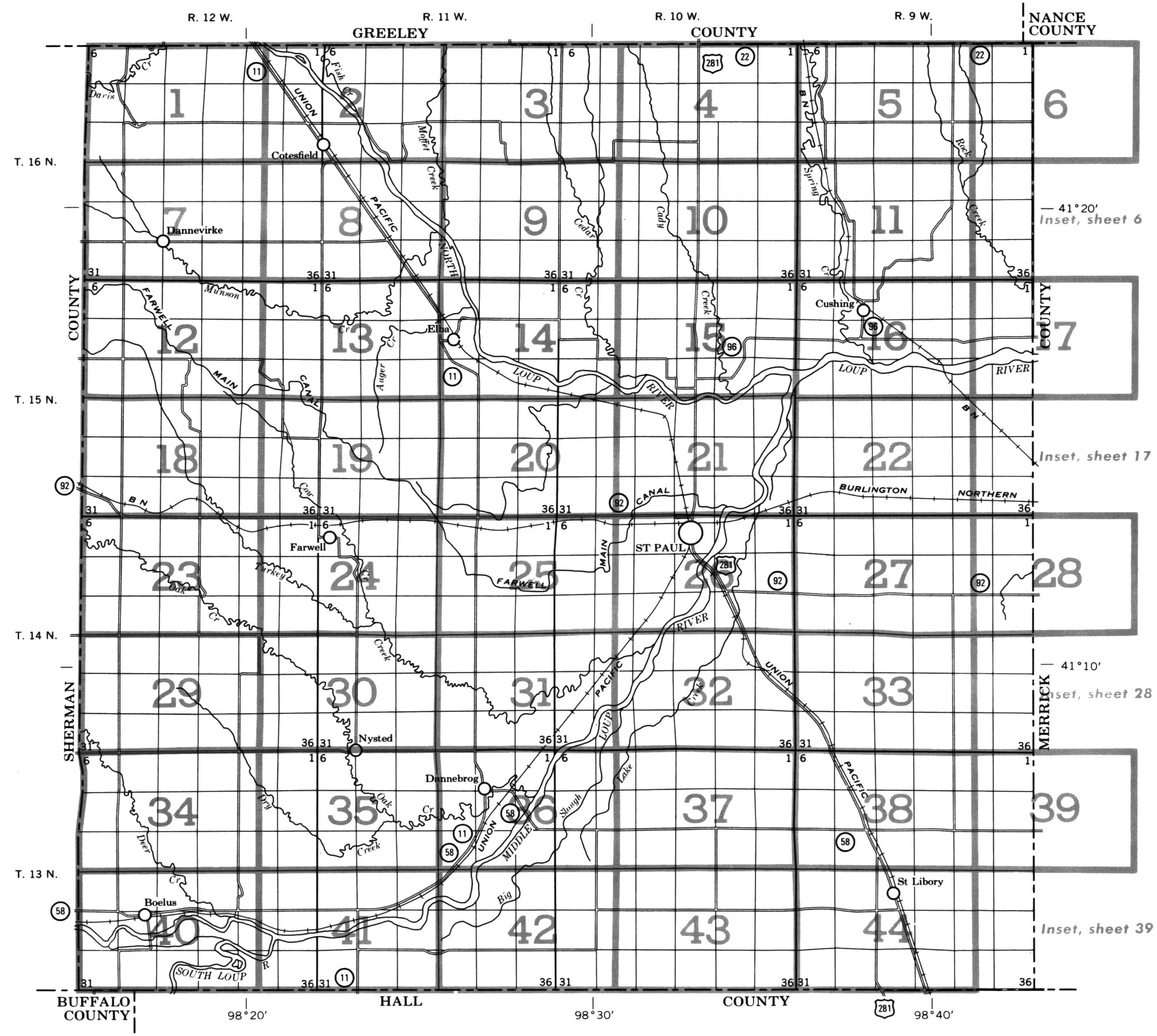
Acreage and extent, table 1, page 9.
Estimated yields, table 2, page 48.

Engineering uses of soils, tables 5, 6, and 7, pages 60 to 79.

Map symbol	Mapping unit	Page	Capability unit: Symbol	Page	Range site: Name	Page	Windbreak group: Name	Page
B	Blown-out land	8	VIIe-5 dryland	47	Sands	54	Very Sandy	57
Boa	Boel loamy fine sand	10	IIIw-5 dryland, IIIw-5 irrigated	42	Subirrigated	51	Moderately Wet	57
Bob	Boel fine sandy loam	10	IIIw-6 dryland, IIw-61 irrigated	42	Subirrigated	51	Moderately Wet	57
Boc	Boel loam	10	IIw-4 dryland, IIw-4 irrigated	39	Subirrigated	51	Moderately Wet	57
CbC	Coly silt loam, 5 to 11 percent slopes	11	IVe-8 dryland	43	Limy Upland	54	Silty to Clayey	56
CbD	Coly silt loam, 11 to 31 percent slopes	11	VIe-8 dryland	46	Limy Upland	54	Silty to Clayey	56
CUD	Coly-Uly complex, 15 to 31 percent slopes	11						
	Coly soil	--	VIe-9 dryland	46	Limy Upland	54	Silty to Clayey	56
	Uly soil	--	VIe-9 dryland	46	Silty	54	Silty to Clayey	56
Da	Darr fine sandy loam	12	IIe-3 dryland, IIe-3 irrigated	38	Sandy Lowland	52	Sandy	57
Db	Darr silt loam	12	I-1 dryland, I-1 irrigated	36	Sandy Lowland	52	Silty to Clayey	56
De	Detroit silt loam, 0 to 1 percent slopes	13	IIs-2 dryland, IIs-2 irrigated	39	Silty Lowland	53	Silty to Clayey	56
Ea	Elsmere loamy fine sand	13	IIIw-5 dryland, IIIw-5 irrigated	42	Subirrigated	51	Moderately Wet	57
Gg	Gibbon silt loam	14	IIw-4 dryland, IIw-4 irrigated	39	Subirrigated	51	Moderately Wet	57
Gk	Grigston silt loam	15	I-1 dryland, I-1 irrigated	36	Silty Lowland	53	Silty to Clayey	56
GsC3	Geary soils, 7 to 11 percent slopes, severely eroded	14	IVe-8 dryland	43	Silty	54	Silty to Clayey	56
GsD3	Geary soils, 11 to 15 percent slopes, severely eroded	14	VIe-8 dryland	46	Silty	54	Silty to Clayey	56
Ha	Hall silt loam, 0 to 1 percent slopes	16	IIc-1 dryland, I-11 irrigated	36	Silty Lowland	53	Silty to Clayey	56
2Hb	Hobbs silt loam, occasionally flooded	17	IIw-3 dryland, I-12 irrigated	38	Silty Overflow	51	Moderately Wet	57
Hb	Hobbs silt loam, 0 to 1 percent slopes	17	I-1 dryland, I-1 irrigated	36	Silty Lowland	53	Silty to Clayey	56
HbA	Hobbs silt loam, 1 to 3 percent slopes	17	IIe-1 dryland, IIe-1 irrigated	37	Silty Lowland	53	Silty to Clayey	56
HbB	Hobbs silt loam, 3 to 5 percent slopes	17	IIe-11 dryland, IIIe-1 irrigated	38	Silty Lowland	53	Silty to Clayey	56
Hd	Hord silt loam, 0 to 1 percent slopes	19	IIc-1 dryland, I-11 irrigated	36	Silty Lowland	53	Silty to Clayey	56
Hg	Holder silt loam, 0 to 1 percent slopes	18	IIc-1 dryland, I-11 irrigated	36	Silty	54	Silty to Clayey	56

Map symbol	Mapping unit	Page	Capability unit: Symbol	Page	Range site: Name	Page	Windbreak group: Name	Page
HgA	Holder silt loam, 1 to 3 percent slopes	18	IIe-1 dryland, IIe-1 irrigated	37	Silty	54	Silty to Clayey	56
HgB2	Holder silt loam, 3 to 5 percent slopes, eroded	18	IIe-11 dryland, IIIe-1 irrigated	38	Silty	54	Silty to Clayey	56
HgC	Holder silt loam, 5 to 11 percent slopes	18	IIIe-1 dryland, IVe-1 irrigated	40	Silty	54	Silty to Clayey	56
HpC2	Holder silty clay loam, 5 to 11 percent slopes, eroded	18	IIIe-1 dryland, IVe-1 irrigated	40	Silty	54	Silty to Clayey	56
HpC3	Holder silty clay loam, 5 to 11 percent slopes, severely eroded	19	IVe-81 dryland, IVe-11 irrigated	43	Silty	54	Silty to Clayey	56
Hs	Hastings silt loam, 0 to 1 percent slopes	16	IIc-1 dryland, I-11 irrigated	36	Silty	54	Silty to Clayey	56
Ia	Inavale loam	21	IIs-51 dryland, IIIe-11 irrigated	40	Sands	54	Sandy	57
If	Inavale fine sand	21	VIe-5 dryland	45	Sands	54	Very Sandy	57
Ig	Inavale loamy fine sand	21	IIIe-5 dryland, IIIe-5 irrigated	41	Sands	54	Sandy	57
In	Inavale fine sandy loam	21	IIIe-3 dryland, IIIe-3 irrigated	40	Sands	54	Sandy	57
Ks	Kenesaw silt loam, 0 to 1 percent slopes	22	IIc-1 dryland, I-11 irrigated	36	Silty	54	Silty to Clayey	56
KsB	Kenesaw silt loam, 1 to 5 percent slopes	22 22	IIe-1 dryland, IIe-1 irrigated	37	Silty	54	Silty to Clayey	56
KsC	Kenesaw silt loam, 5 to 11 percent slopes	22	IIIe-1 dryland, IVe-1 irrigated	40	Silty	54	Silty to Clayey	56
KSz	Kenesaw-Slickspots complex	22						
	Kenesaw soil	--	IVs-1 dryland, IIIs-1 irrigated	44	Silty	54	Silty to Clayey	56
	Slickspots	--	IVs-1 dryland, IIIs-1 irrigated	44	Saline Lowland	53	Moderately Saline or Alkali	57
L	Loretto complex, 0 to 5 percent slopes	24	IIe-3 dryland, IIe-3 irrigated	38	Sandy	54	Sandy	57
La	Lamo silt loam	23	IIw-4 dryland, IIw-4 irrigated	39	Subirrigated	51	Moderately Wet	57
LB	Libory-Boelus fine sands	23	IVe-5 dryland	42	Sands	54	Very Sandy	57
LC	Libory-Boelus loamy fine sands	23	IIIe-5 dryland, IIIe-5 irrigated	41	Sandy	54	Sandy	57
M	Marsh	24	VIIIw-1 dryland	47	--------------	--	Undesirable	58
NsD3	Nuckolls soils, 15 to 31 percent slopes, severely eroded	25	VIe-8 dryland	46	Silty	54	Silty to Clayey	56
Oa	Ovina loamy fine sand	28	IIIw-5 dryland, IIIw-5 irrigated	42	Subirrigated	51	Moderately Wet	57

Map symbol	Mapping unit	Page	Capability unit: Symbol	Page	Range site: Name	Page	Windbreak group: Name	Page
ObB	Ortello loamy fine sand, 1 to 5 percent slopes------------------------	27	IIIe-5 dryland, IIIe-5 irrigated	41	Sandy	54	Sandy	57
Oe	Ord loam----------------------------	26	IIw-4 dryland, IIw-4 irrigated	39	Subirrigated	51	Moderately Wet	57
Of	Ord fine sandy loam------------------	26	IIw-6 dryland, IIw-6 irrigated	39	Subirrigated	51	Moderately Wet	57
Ok	O'Neill loam, 0 to 3 percent slopes---	25	IIs-5 dryland, IIe-11 irrigated	39	Sandy	54	Silty to Clayey	56
OrA	Ortello fine sandy loam, 0 to 1 percent slopes------------------------	27	IIe-3 dryland, IIe-3 irrigated	38	Sandy	54	Sandy	57
Ot	Ortello loam, 0 to 1 percent slopes---	27	IIc-1 dryland, I-11 irrigated	36	Sandy	54	Sandy	57
OtB	Ortello loam, 1 to 5 percent slopes---	27	IIe-1 dryland, IIe-1 irrigated	37	Sandy	54	Sandy	57
OxD	Ortello-Coly complex, 15 to 31 percent slopes----------------------------	27						
	Ortello soil----------------------	--	VIe-3 dryland	44	Sandy	54	Sandy	57
	Coly soil-------------------------	--	VIe-3 dryland	44	Limy Upland	54	Silty to Clayey	56
RB	Rough broken land, loess--------------	28	VIIe-1 dryland	46	Thin Loess	54	Silty to Clayey	56
Ru	Rusco silt loam-----------------------	29	IIw-3 dryland, I-12 irrigated	38	Silty Lowland	53	Moderately Wet	57
Sm	Simeon loamy sand, 0 to 3 percent slopes----------------------------	30	VIs-4 dryland	46	Shallow to Gravel	54	Shallow	57
SS	Silver Creek-Slickspots complex-------	30						
	Silver Creek soil-------------------	--	IVs-1 dryland, IIIs-1 irrigated	44	Subirrigated	51	Moderately Wet	57
	Slickspots-------------------------	--	IVs-1 dryland, IIIs-1 irrigated	44	Saline Lowland	53	Moderately Saline or Alkali	57
Sy	Silty alluvial land-------------------	29	VIw-1 dryland	46	Silty Overflow	51	Moderately Wet	57
TfB	Thurman fine sand, 0 to 5 percent slopes------------------------------	32	VIe-5 dryland	45	Sandy Lowland	52	Very Sandy	57
ThA	Thurman loamy fine sand, 0 to 3 percent slopes--------------------	32	IIIe-51 dryland, IVe-5 irrigated	42	Sandy	54	Sandy	57
ThB	Thurman loamy fine sand, 3 to 5 percent slopes--------------------	32	IVe-51 dryland, IVe-51 irrigated	43	Sandy	54	Sandy	57
2ThA	Thurman loamy fine sand, loamy substratum, 0 to 3 percent slopes------	32	IIIe-51 dryland, IVe-5 irrigated	42	Sandy	54	Sandy	57
2To	Tryon soils, drained------------------	33	Vw-1 dryland	44	Subirrigated	51	Moderately Wet	57
Ty	Tryon loam----------------------------	33	Vw-1 dryland	44	Wet Land	50	Very Wet	57
UsC	Uly silt loam, 5 to 11 percent slopes-	34	IIIe-1 dryland, IVe-1 irrigated	40	Silty	54	Silty to Clayey	56
UsD	Uly silt loam, 11 to 15 percent slopes----------------------------	34	VIe-1 dryland	44	Silty	54	Silty to Clayey	56
VaC	Valentine/fine sand, rolling---------	35	VIe-5 dryland	45	Sands	54	Very Sandy	57
VTD	Valentine and Thurman soils, 0 to 17 percent slopes-------------------	35	VIe-5 dryland	45	Sands	54	Very Sandy	57



INDEX TO MAP SHEETS

HOWARD COUNTY, NEBRASKA

Scale 1:190,080

1 0 1 2 3 4 Miles

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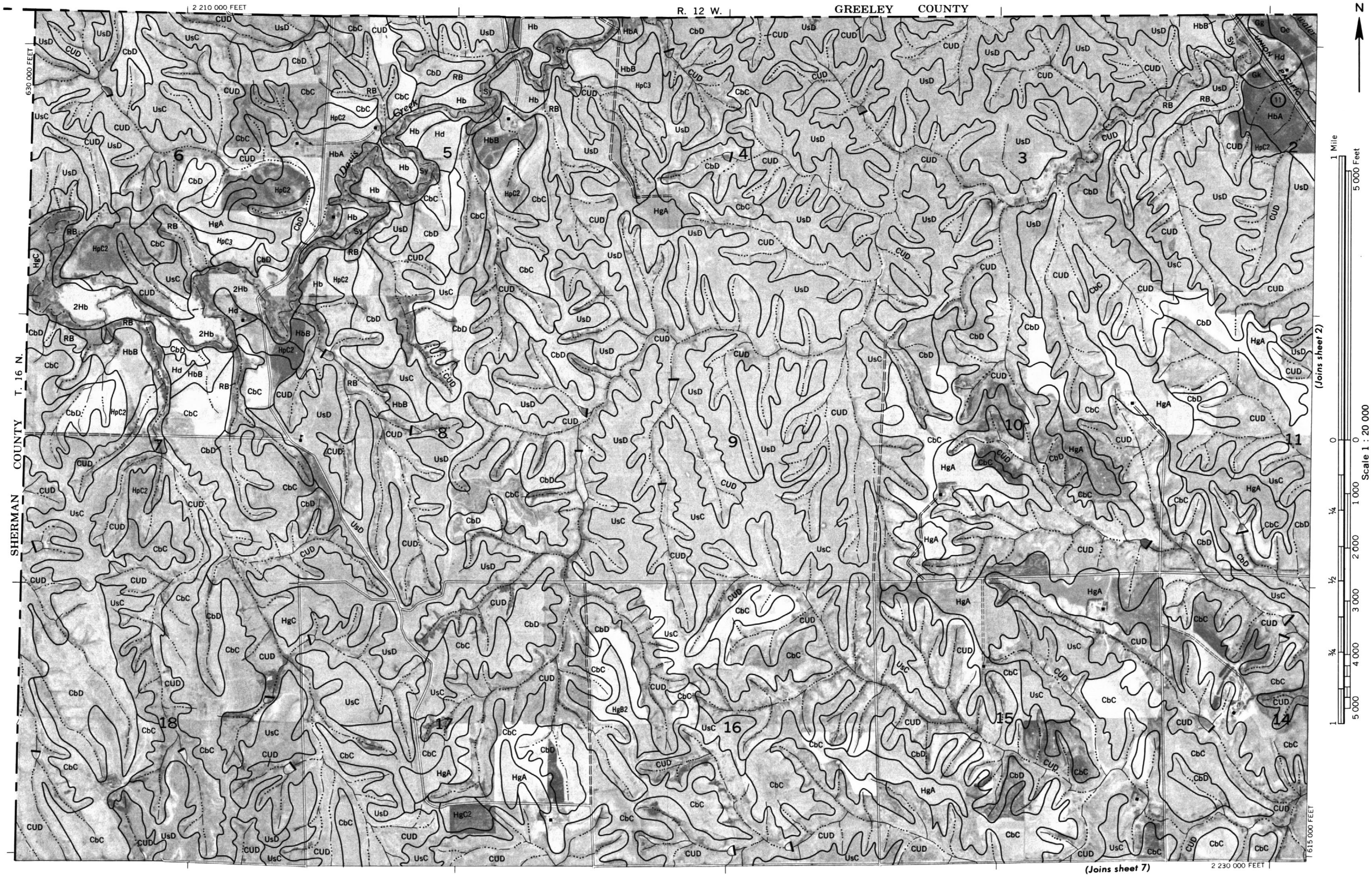

HOWARD COUNTY, NEBRASKA NO. 1

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.

Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.

Land division corners are approximately positioned on this map.

HOWARD COUNTY, NEBRASKA — SHEET NUMBER 2

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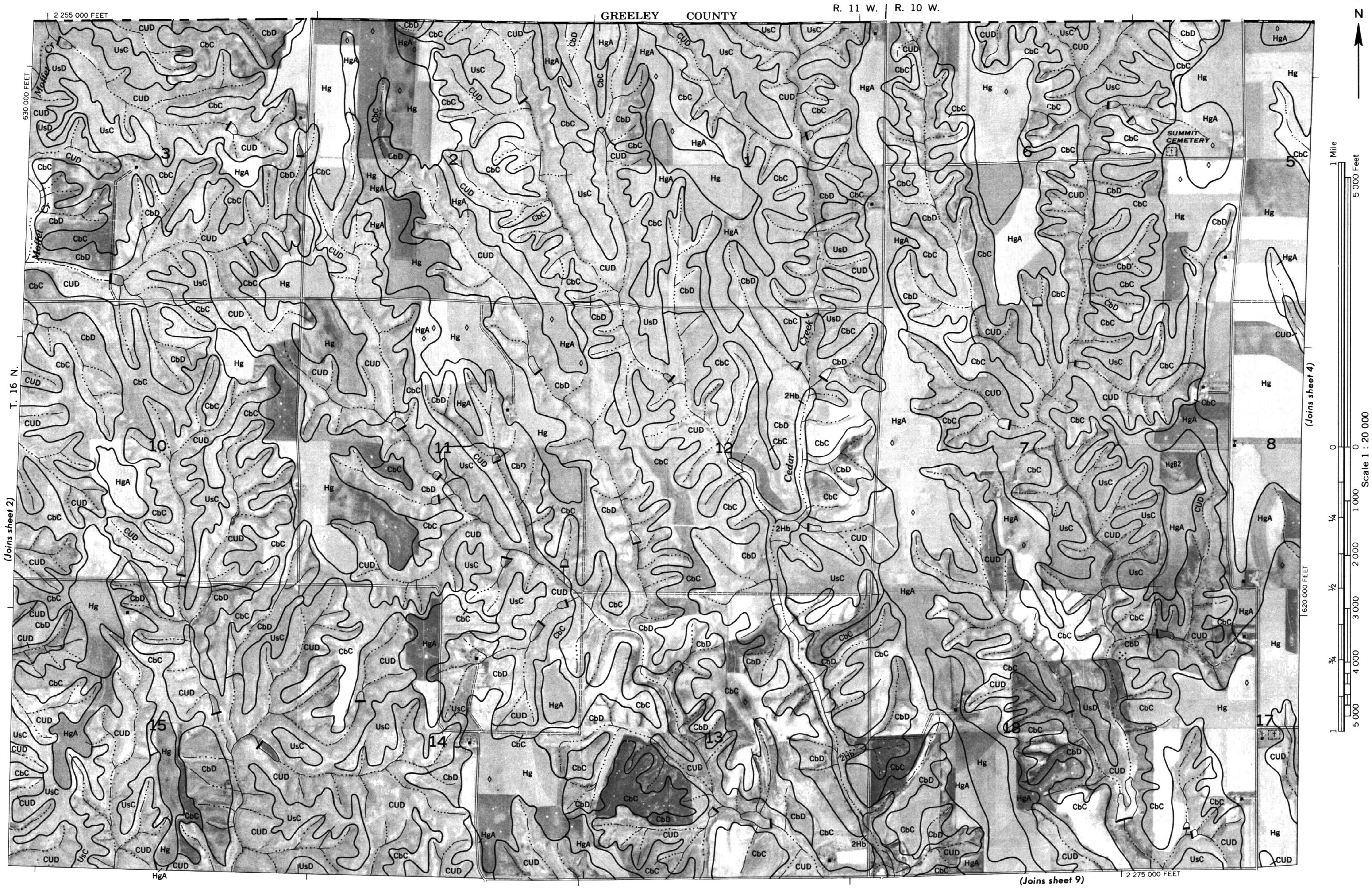
HOWARD COUNTY, NEBRASKA — SHEET NUMBER 3



HOWARD COUNTY, NEBRASKA NO. 3

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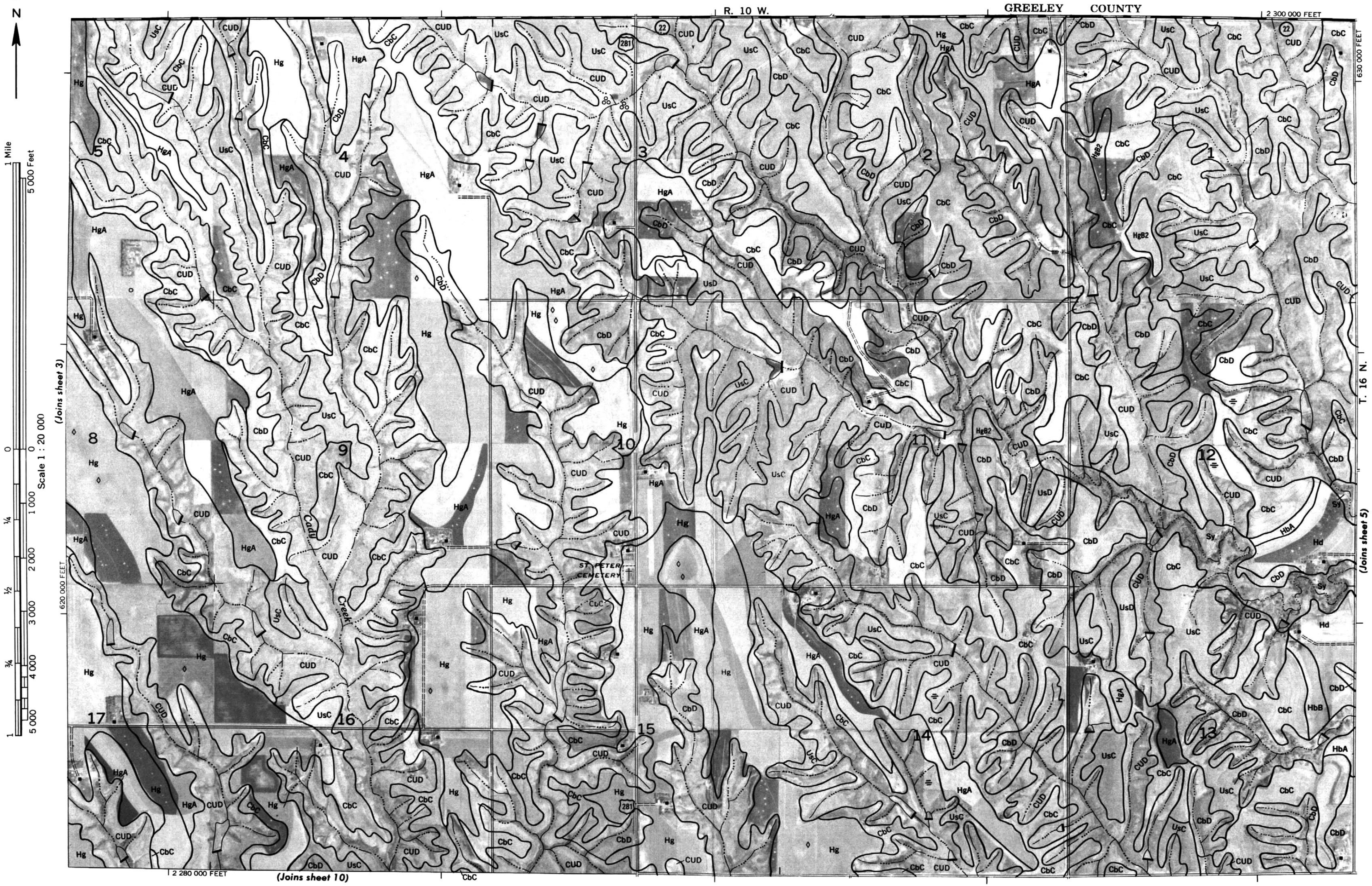

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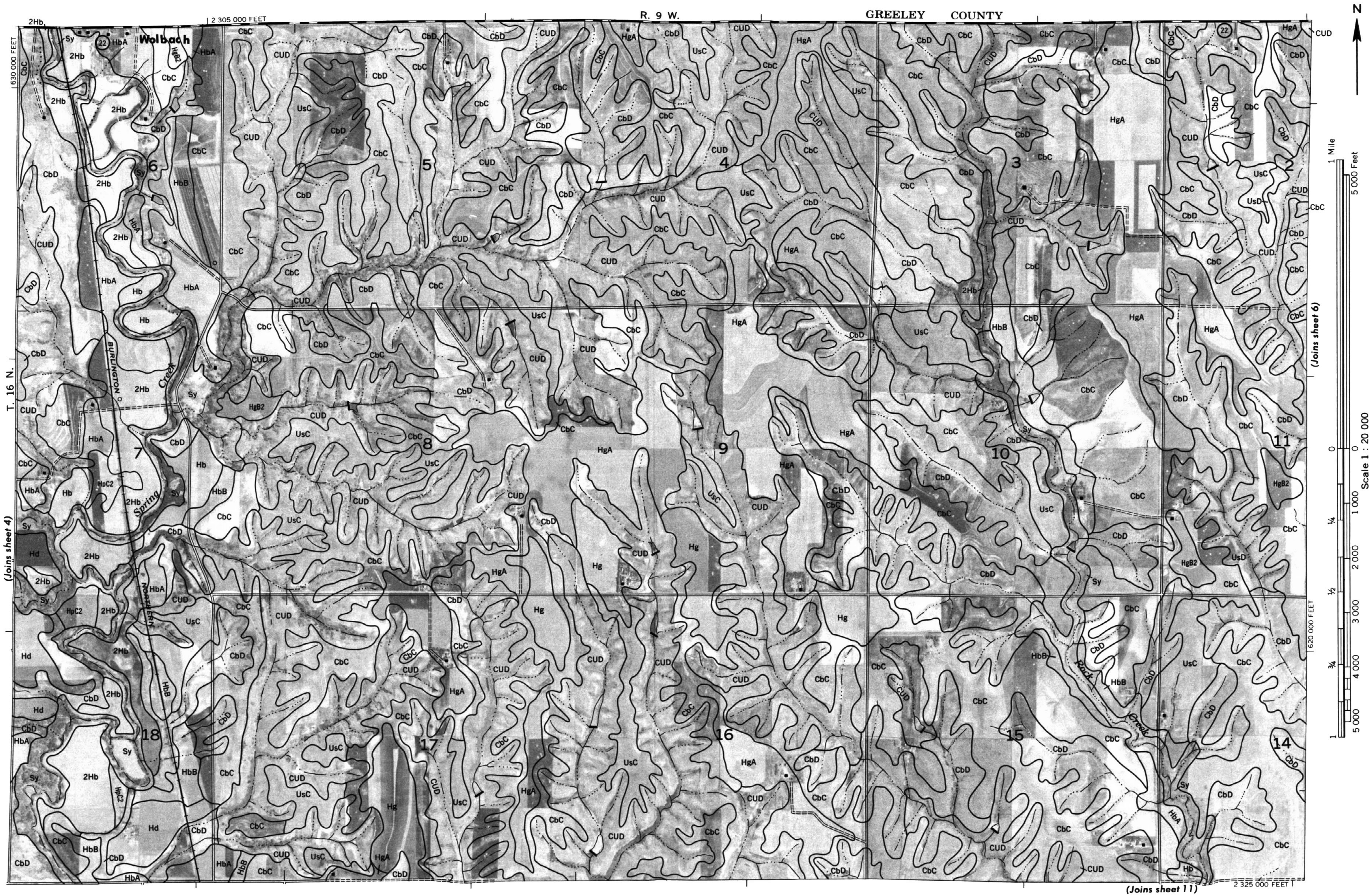

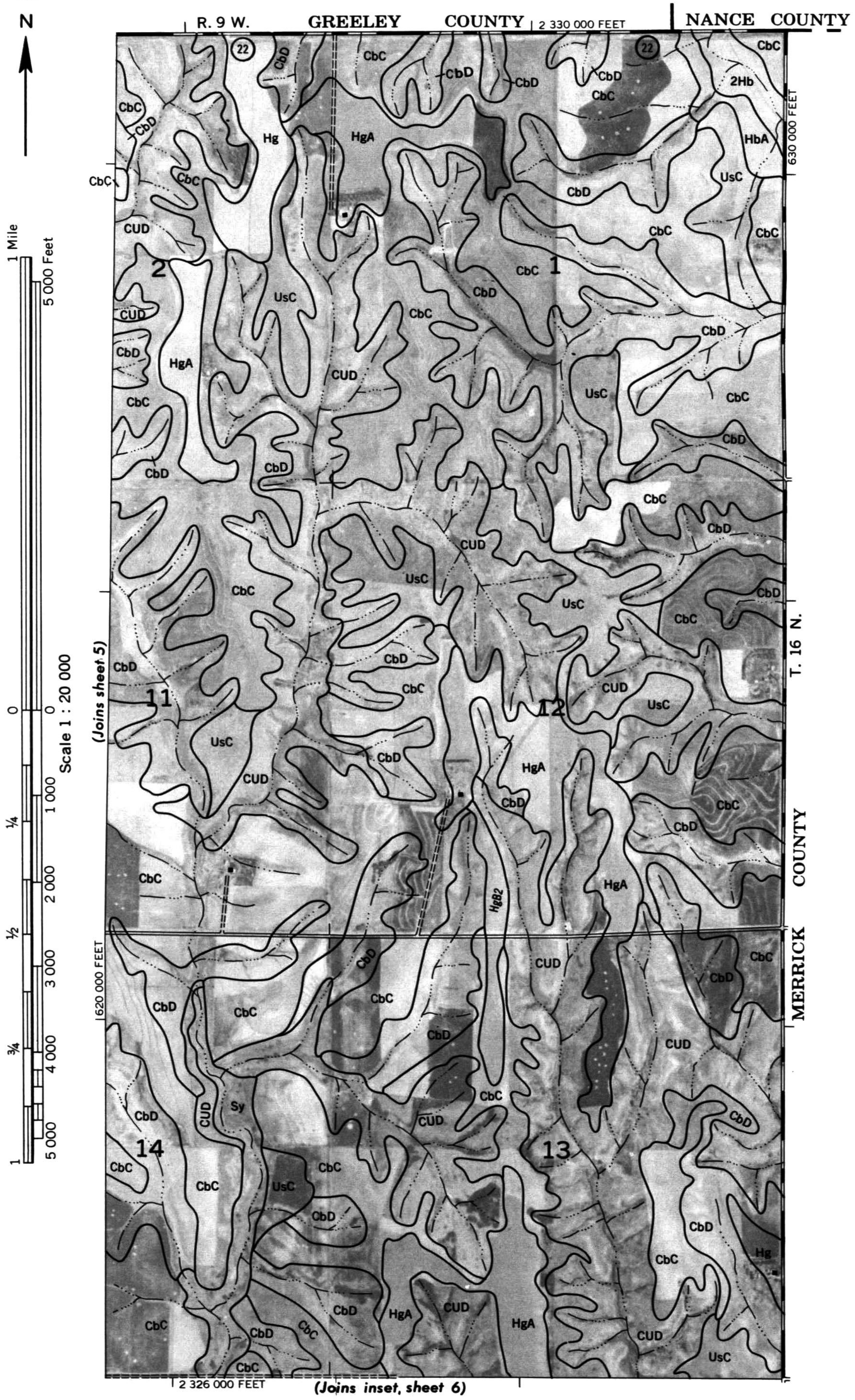

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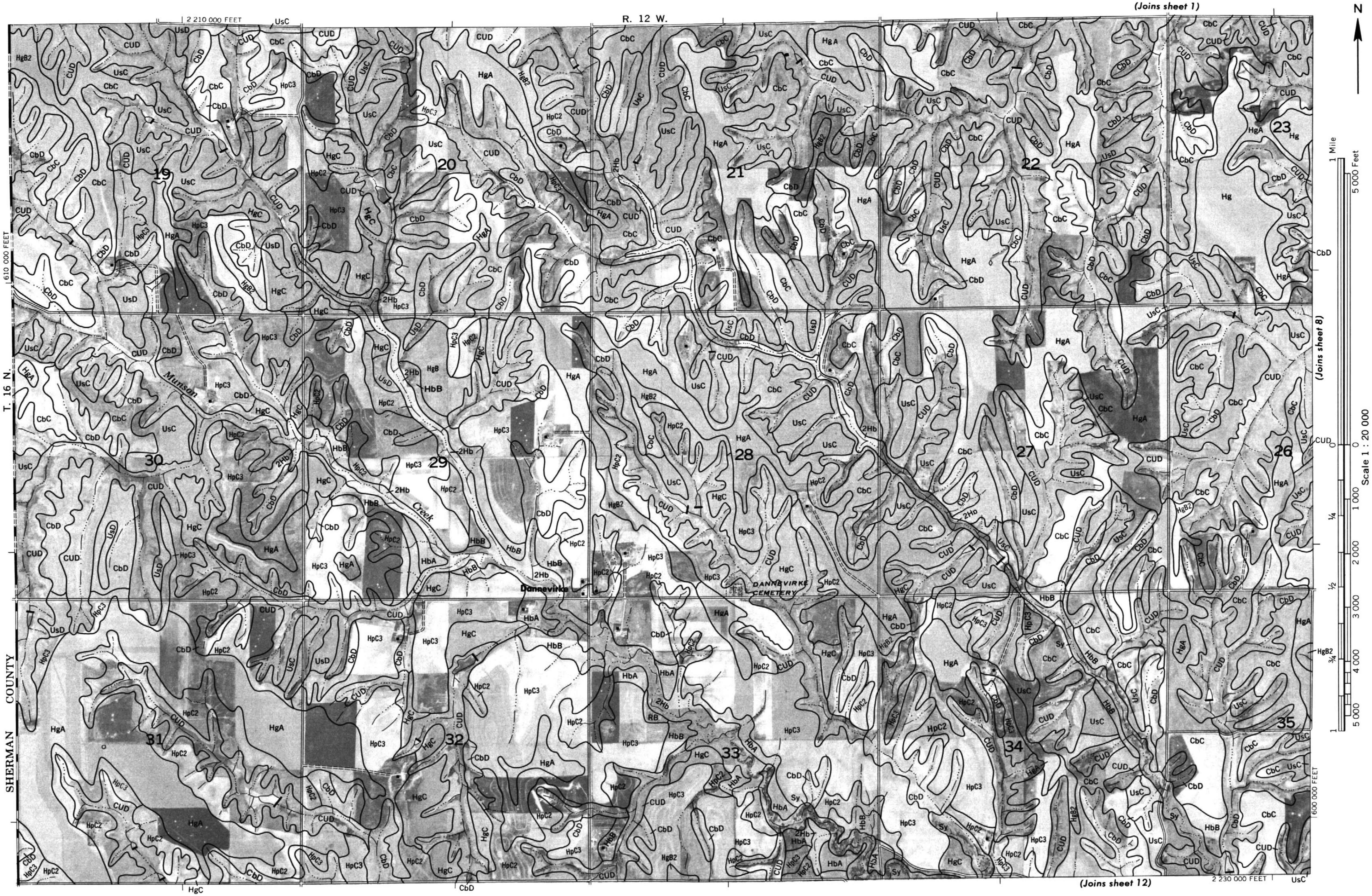

HOWARD COUNTY, NEBRASKA NO. 7

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Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.

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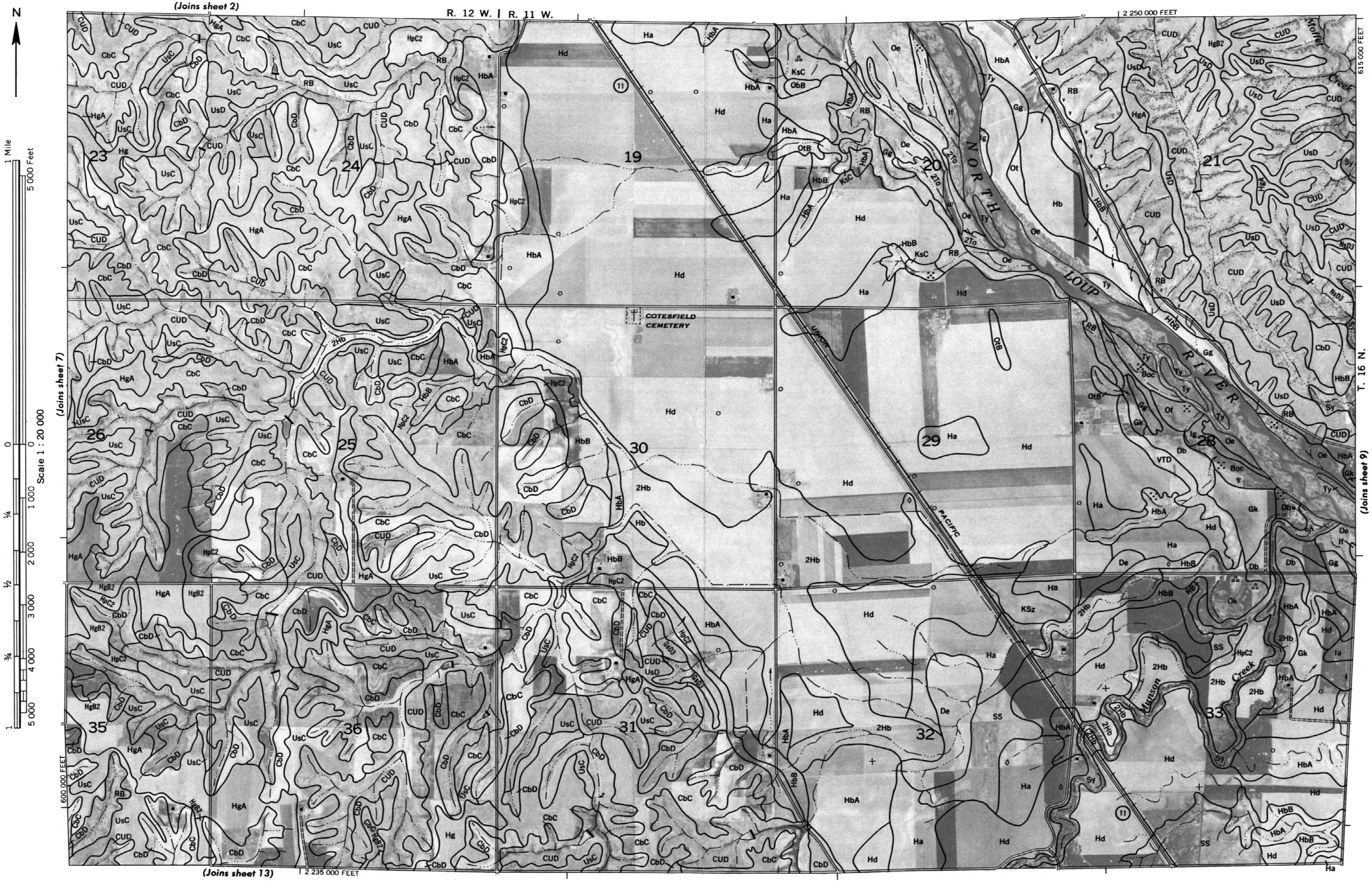
HOWARD COUNTY, NEBRASKA — SHEET NUMBER 8



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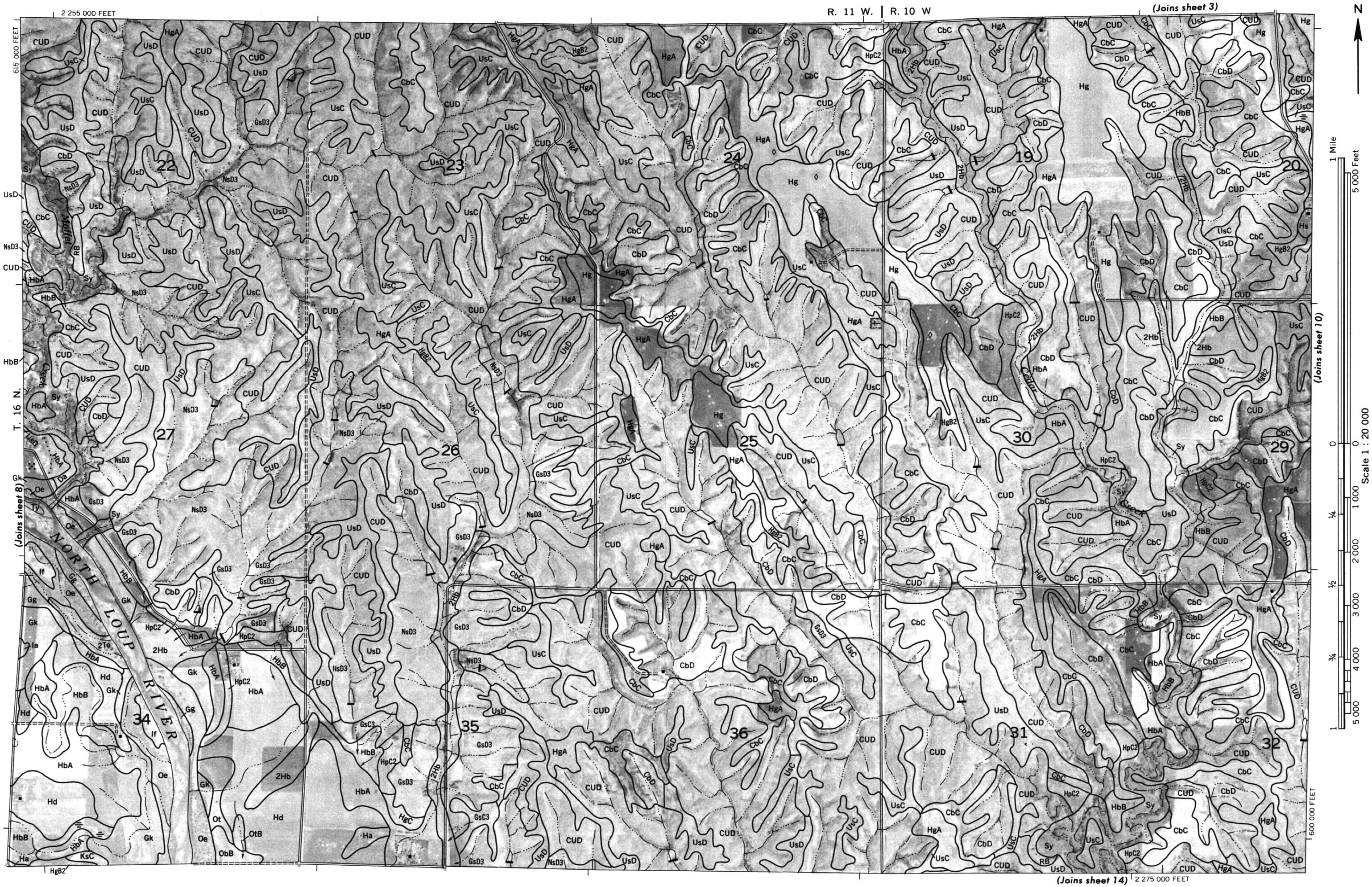

HOWARD COUNTY, NEBRASKA, NO. 9

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Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.
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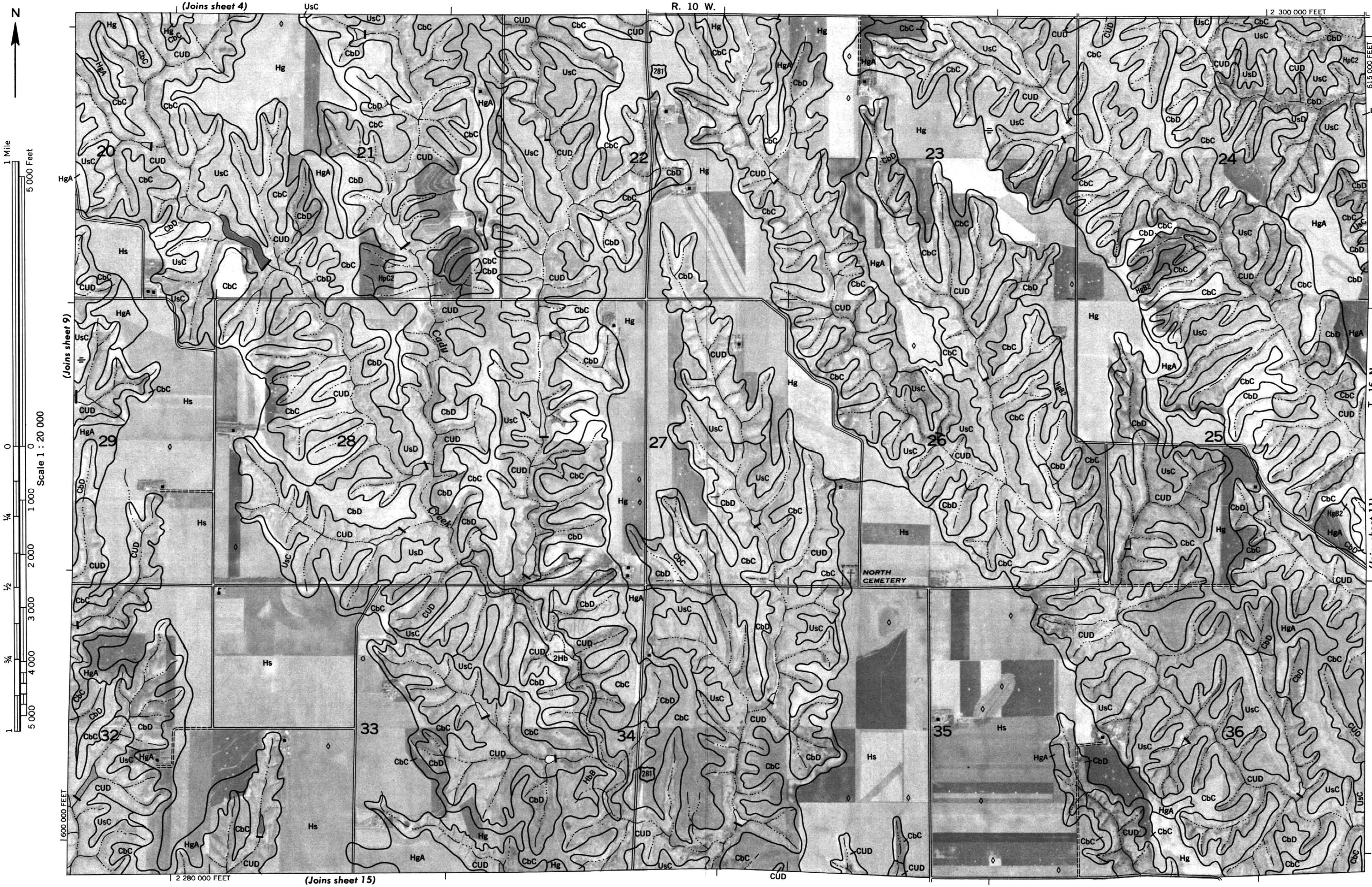
HOWARD COUNTY, NEBRASKA — SHEET NUMBER 10



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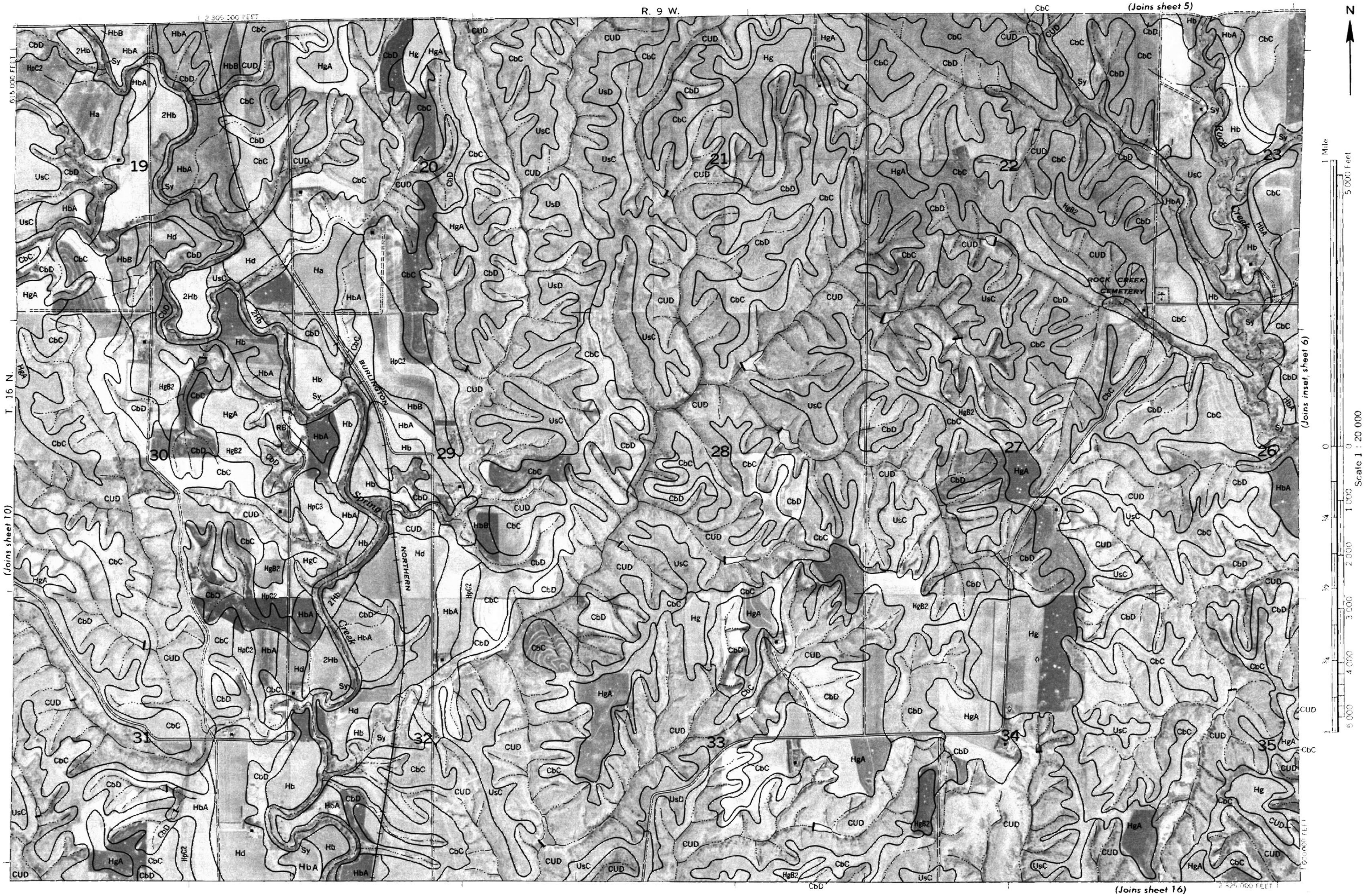

HOWARD COUNTY, NEBRASKA NO. 11

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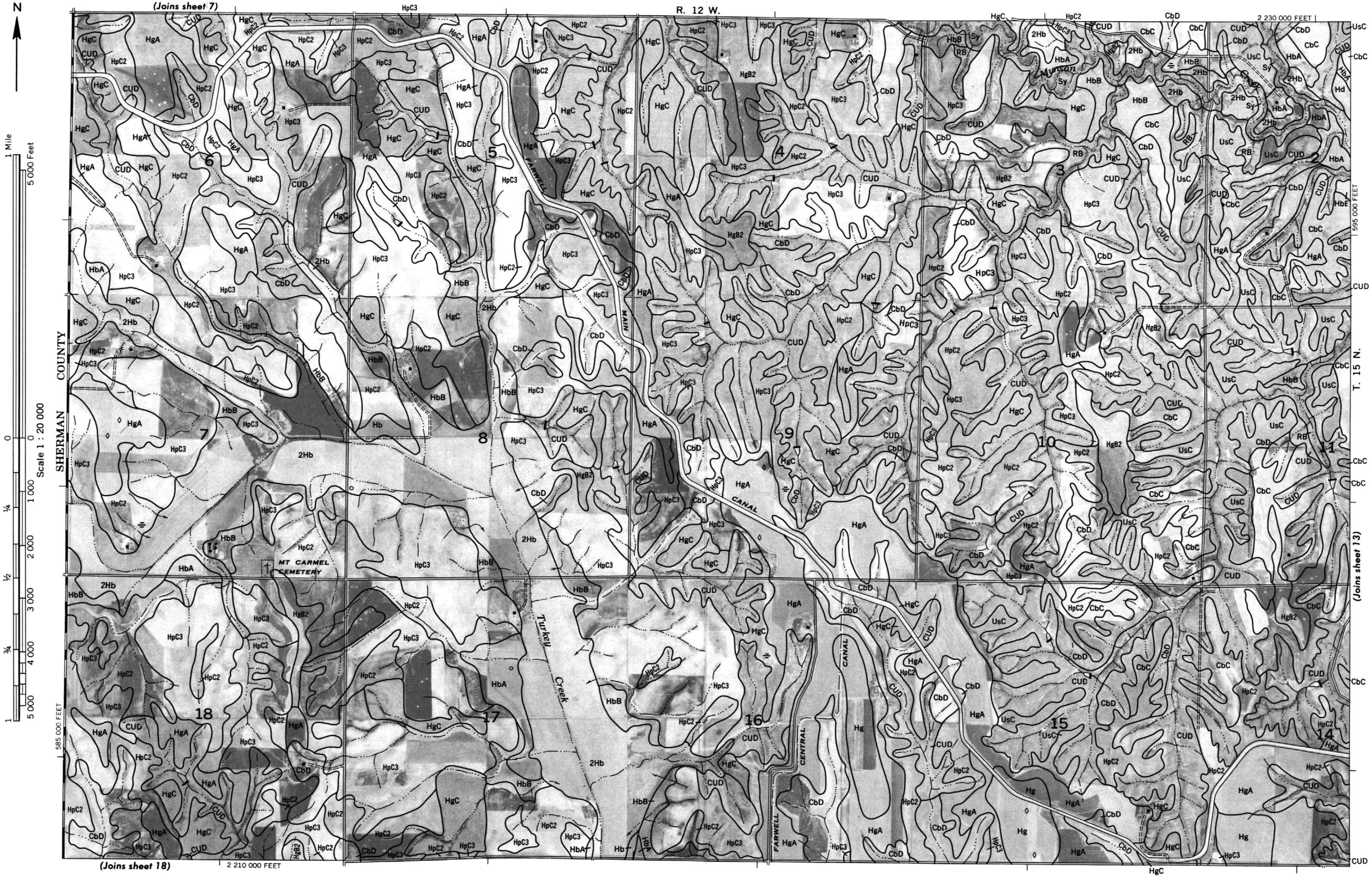
HOWARD COUNTY, NEBRASKA — SHEET NUMBER 12



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HOWARD COUNTY, NEBRASKA NO. 12

HOWARD COUNTY, NEBRASKA NO. 13

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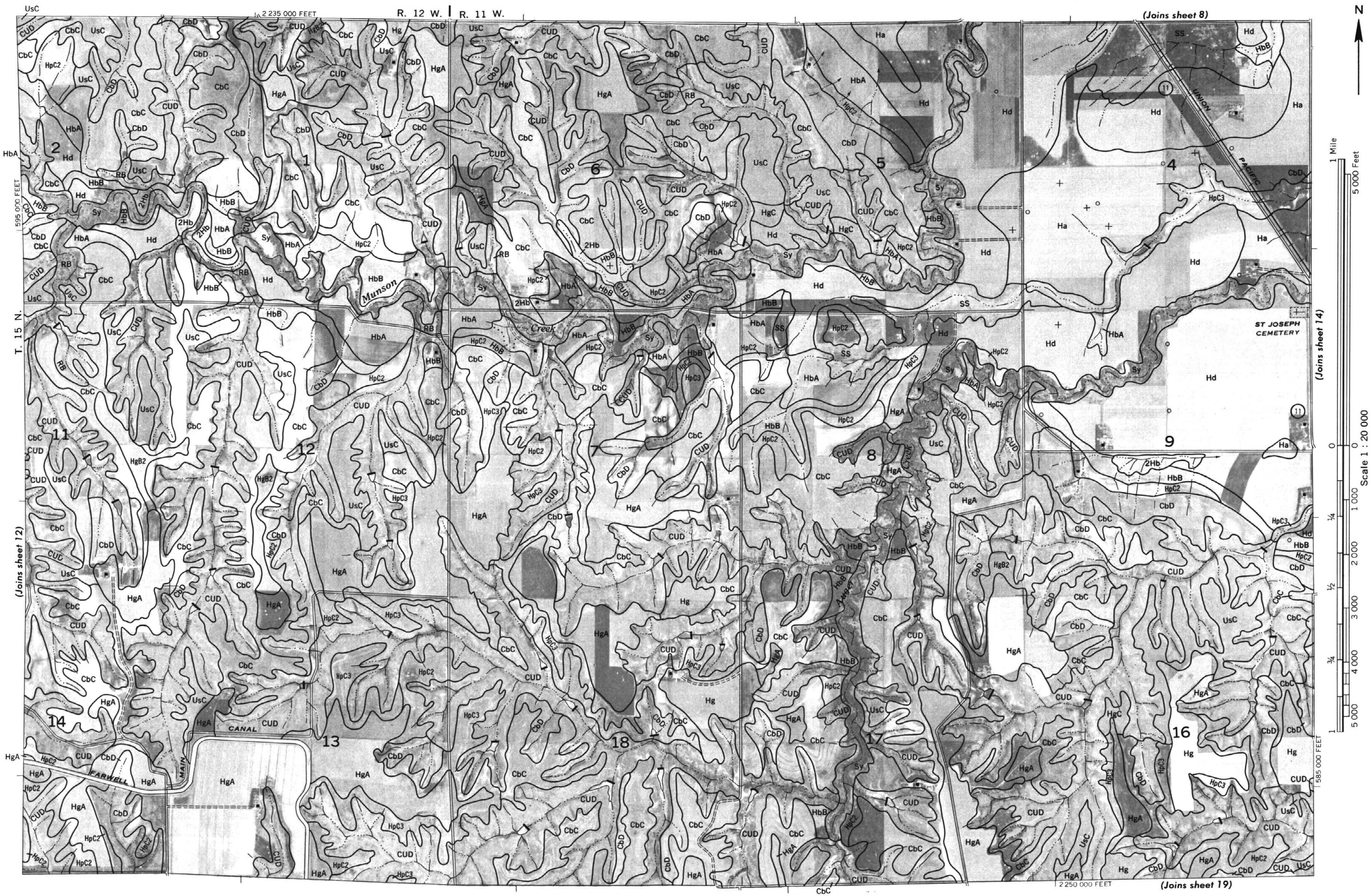

HOWARD COUNTY, NEBRASKA — SHEET NUMBER 14

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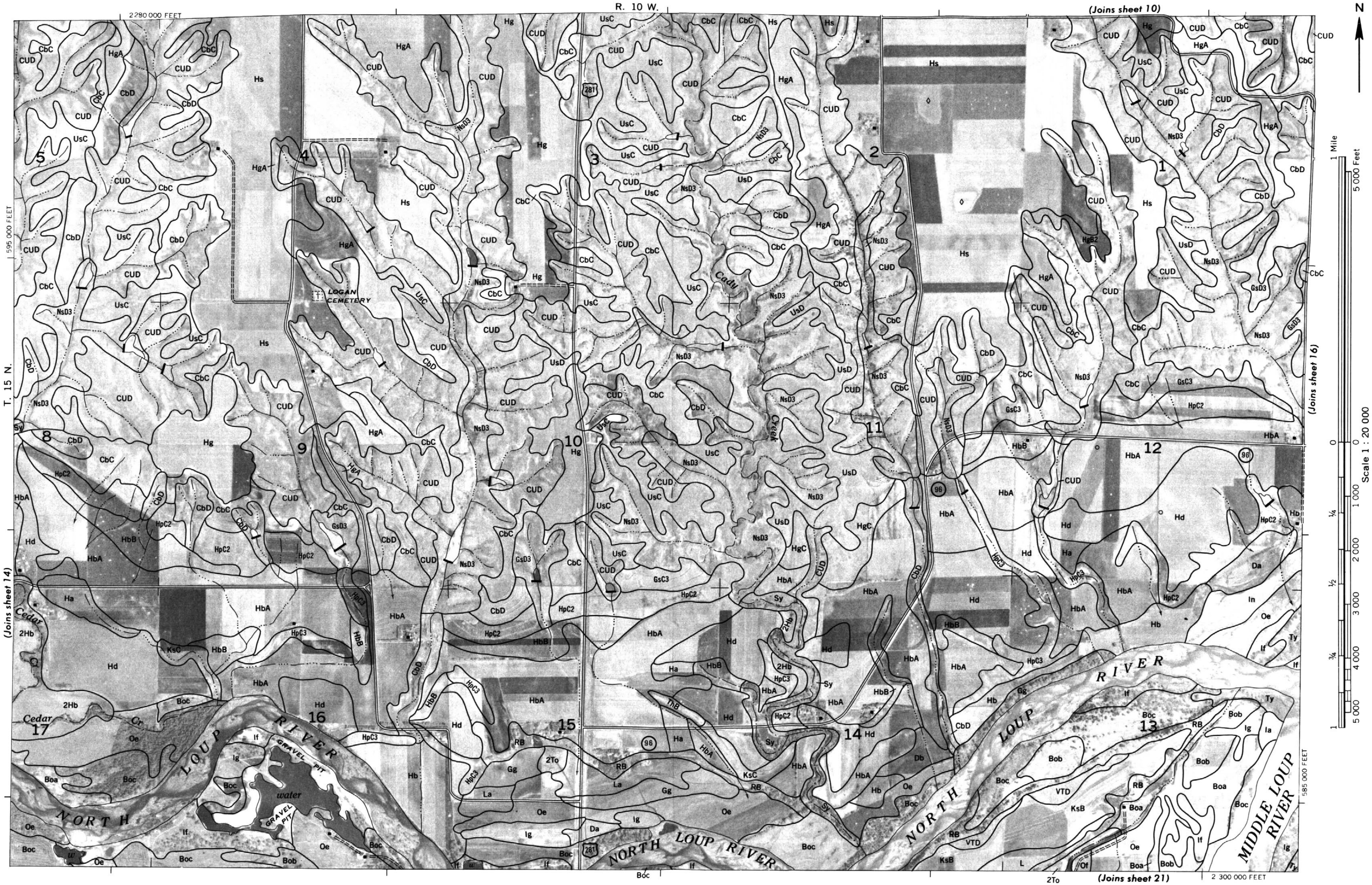

HOWARD COUNTY, NEBRASKA NO. 15

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Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.

Land division corners are approximately positioned on this map.

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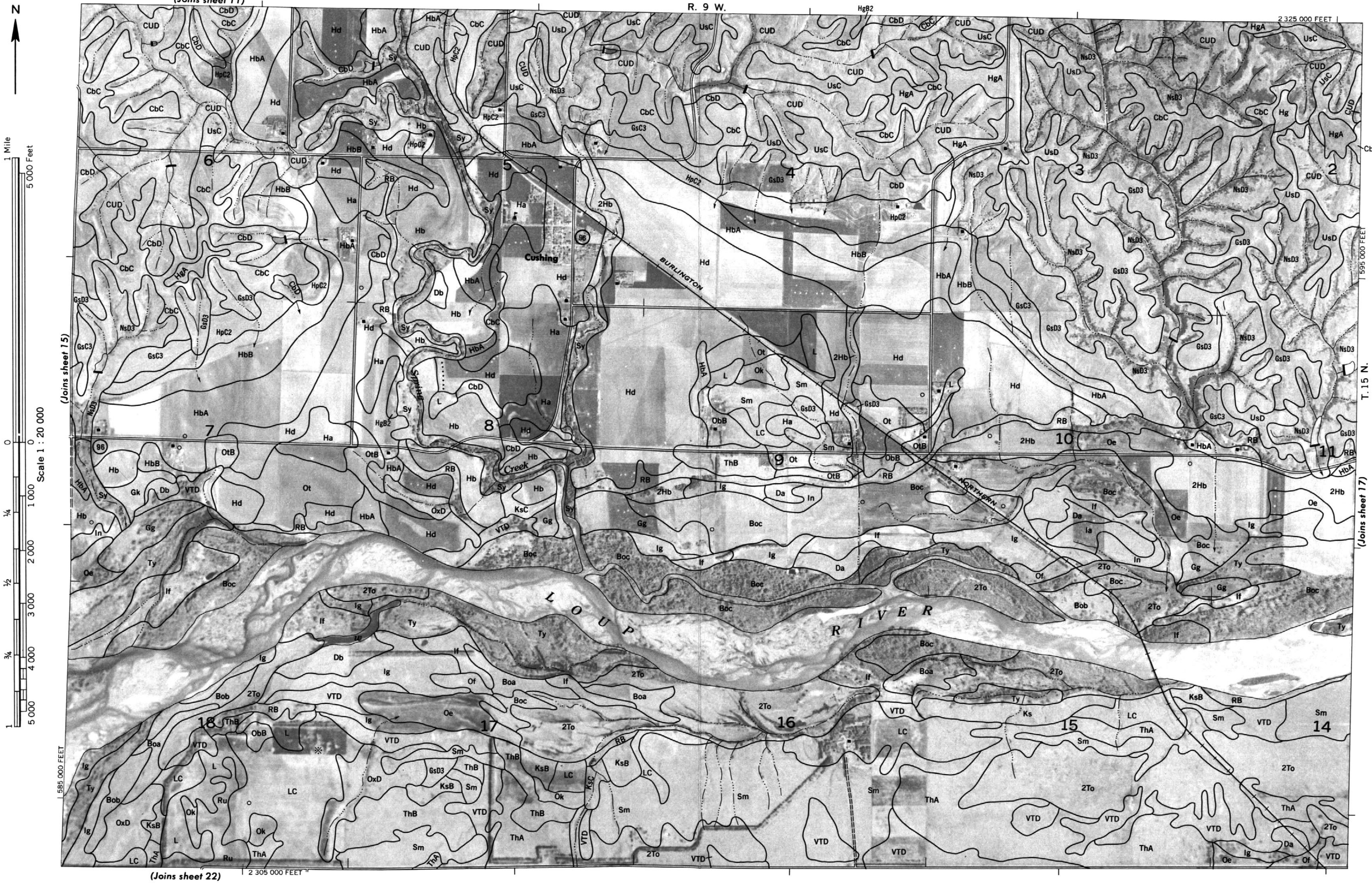
HOWARD COUNTY, NEBRASKA — SHEET NUMBER 16



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HOWARD COUNTY, NEBRASKA NO. 16

HOWARD COUNTY, NEBRASKA NO. 17

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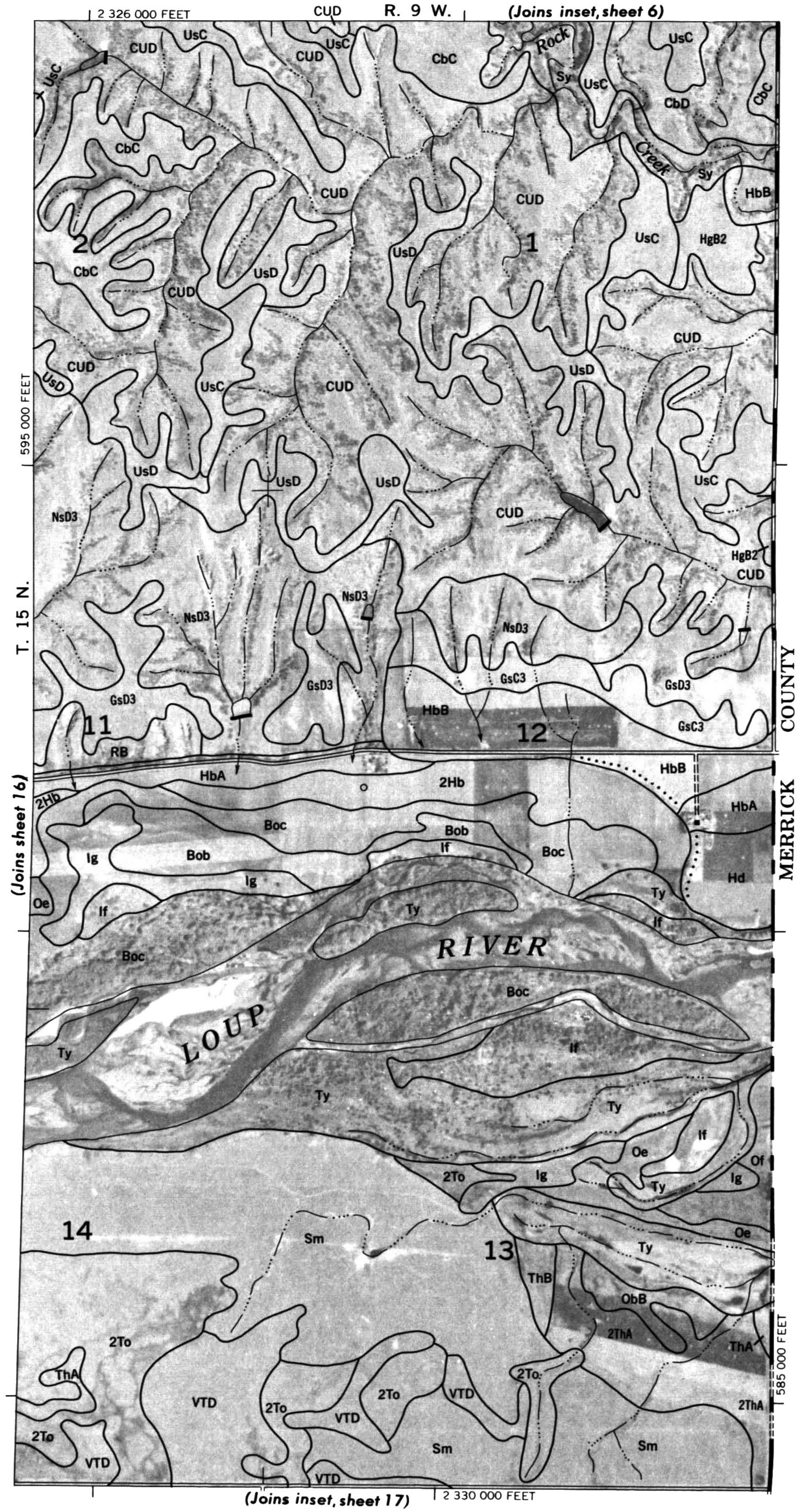
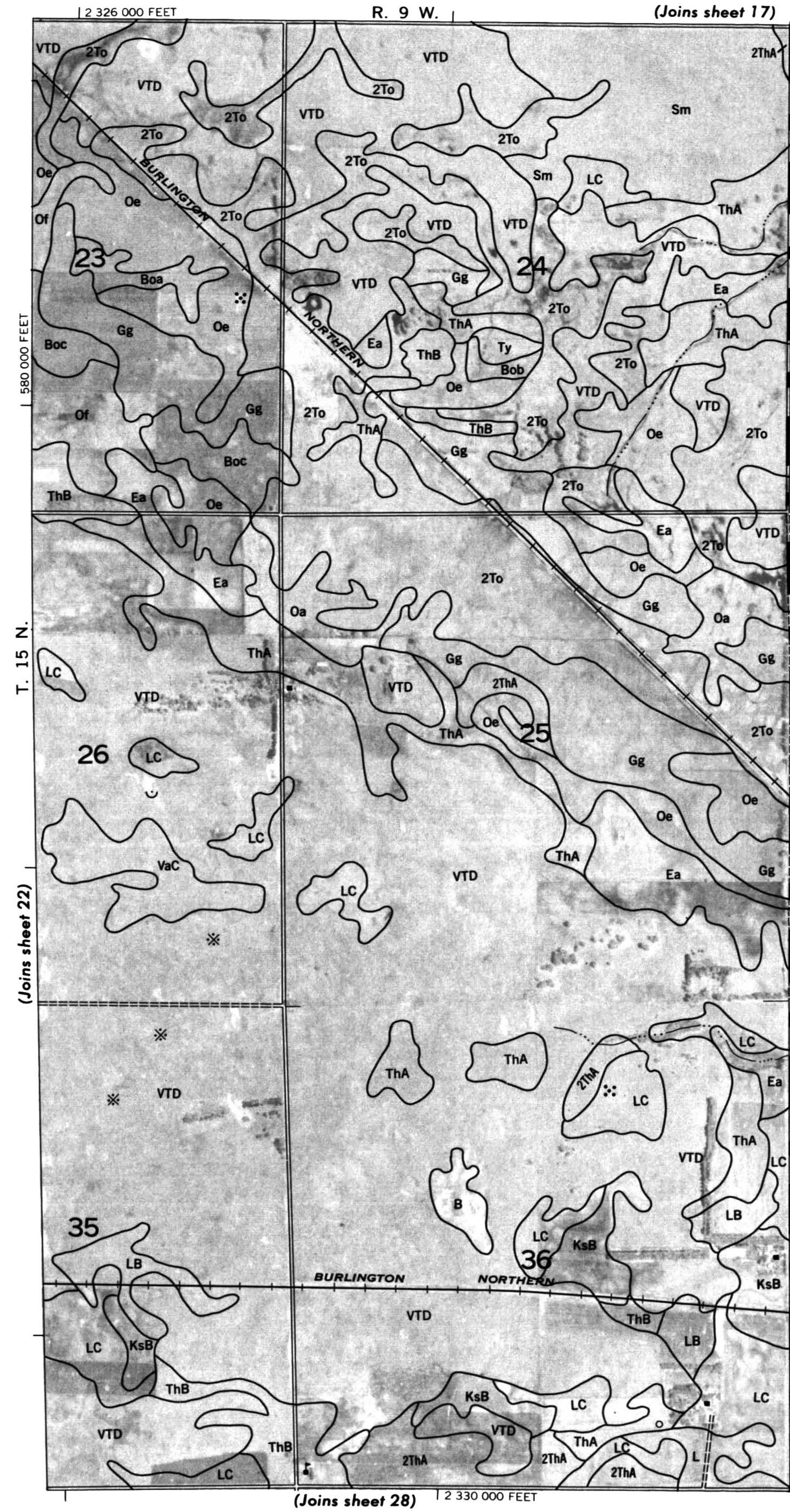


4 000 AND 5 000-FOOT GRID TICKS



4 000 AND 5 000-FOOT GRID TICKS

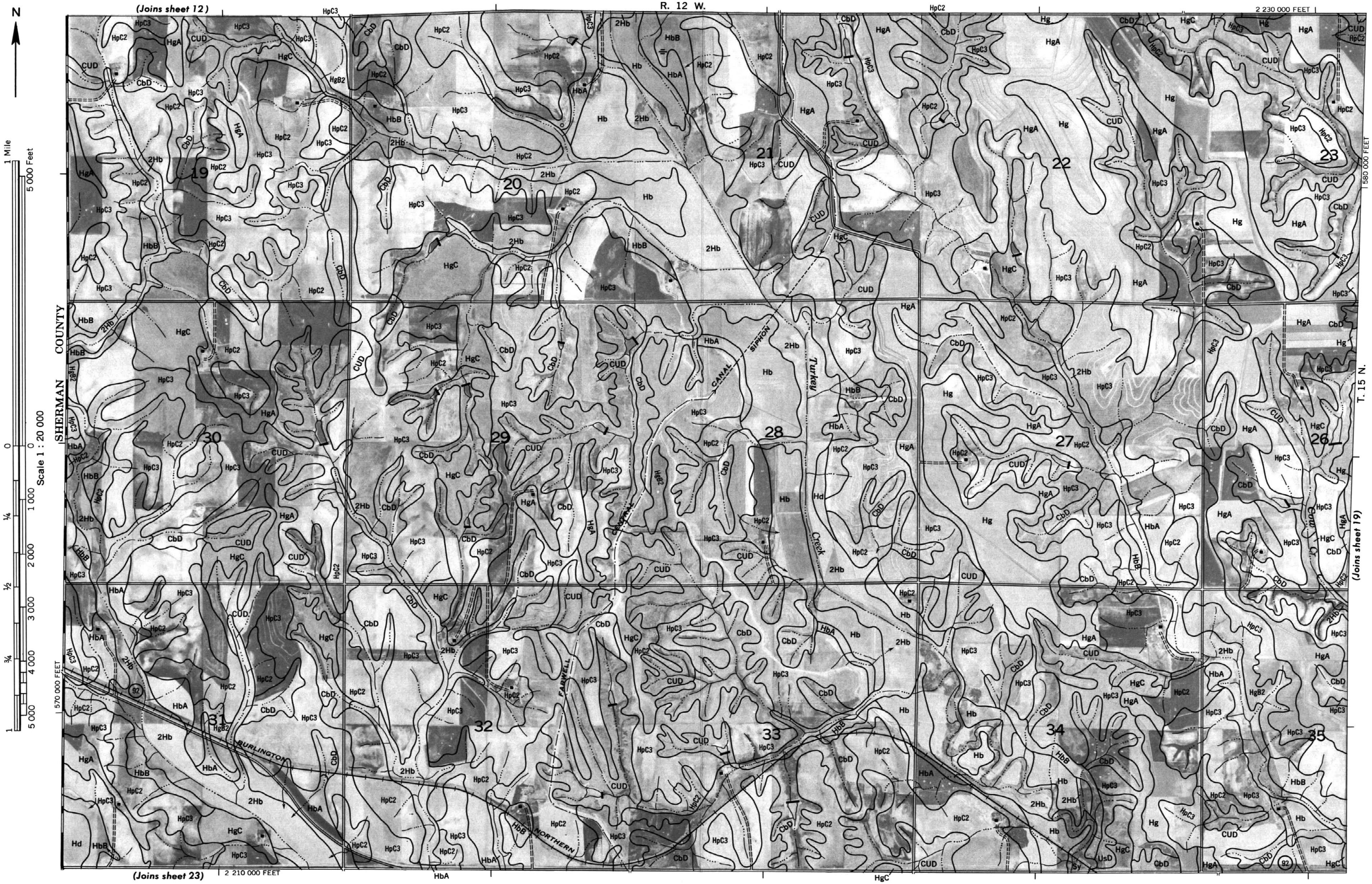
N

1 Mile

5 000 Feet

Scale 1 : 20 000

HOWARD COUNTY, NEBRASKA — SHEET NUMBER 18



Land division corners are approximately positioned on this map.

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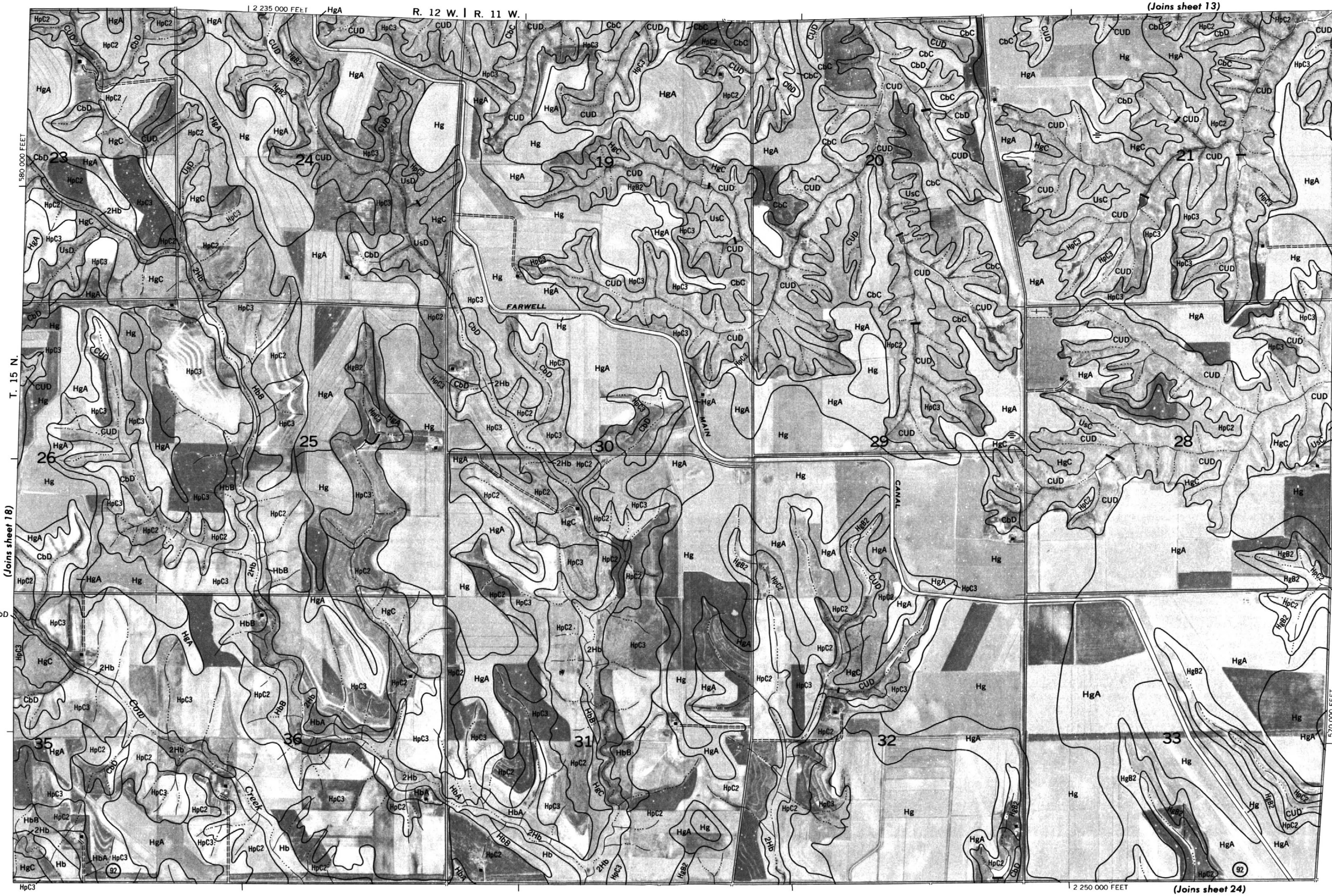
N



1 Mile

5 000 Feet

Scale 1 : 20 000

0 1 000 2 000 3 000 4 000 5 000

0 ¼ ½ ¾ 1

HOWARD COUNTY, NEBRASKA NO. 19

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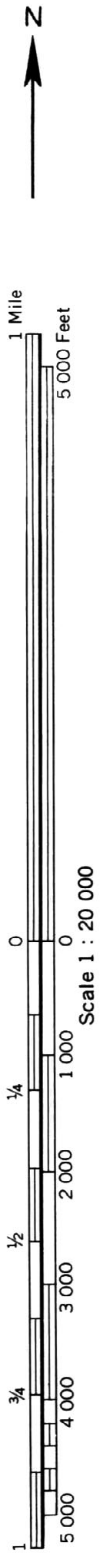
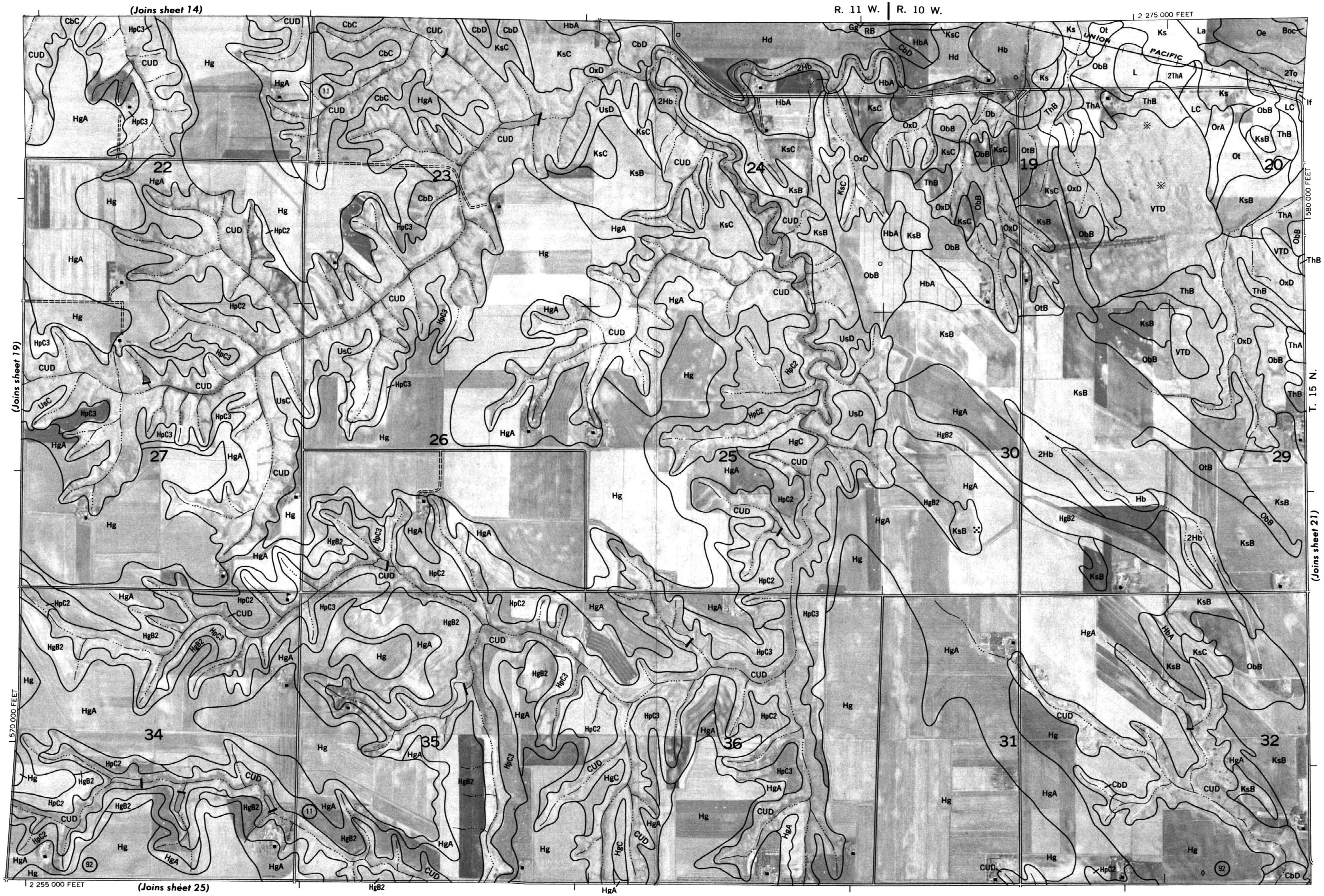
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.
Land division corners are approximately positioned on this map.

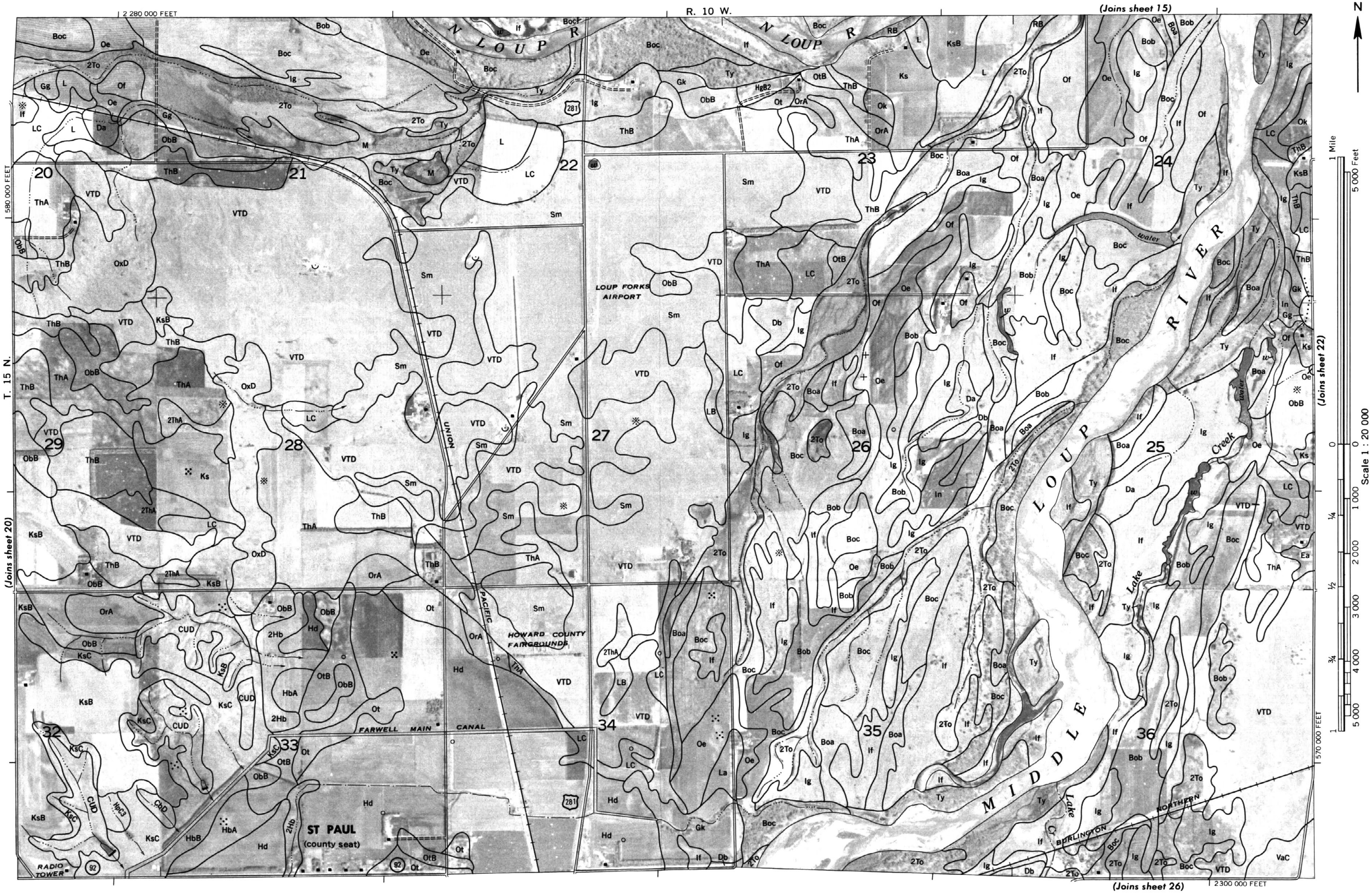
HOWARD COUNTY, NEBRASKA — SHEET NUMBER 20





Land division corners are approximately positioned on this map.
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.
This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.

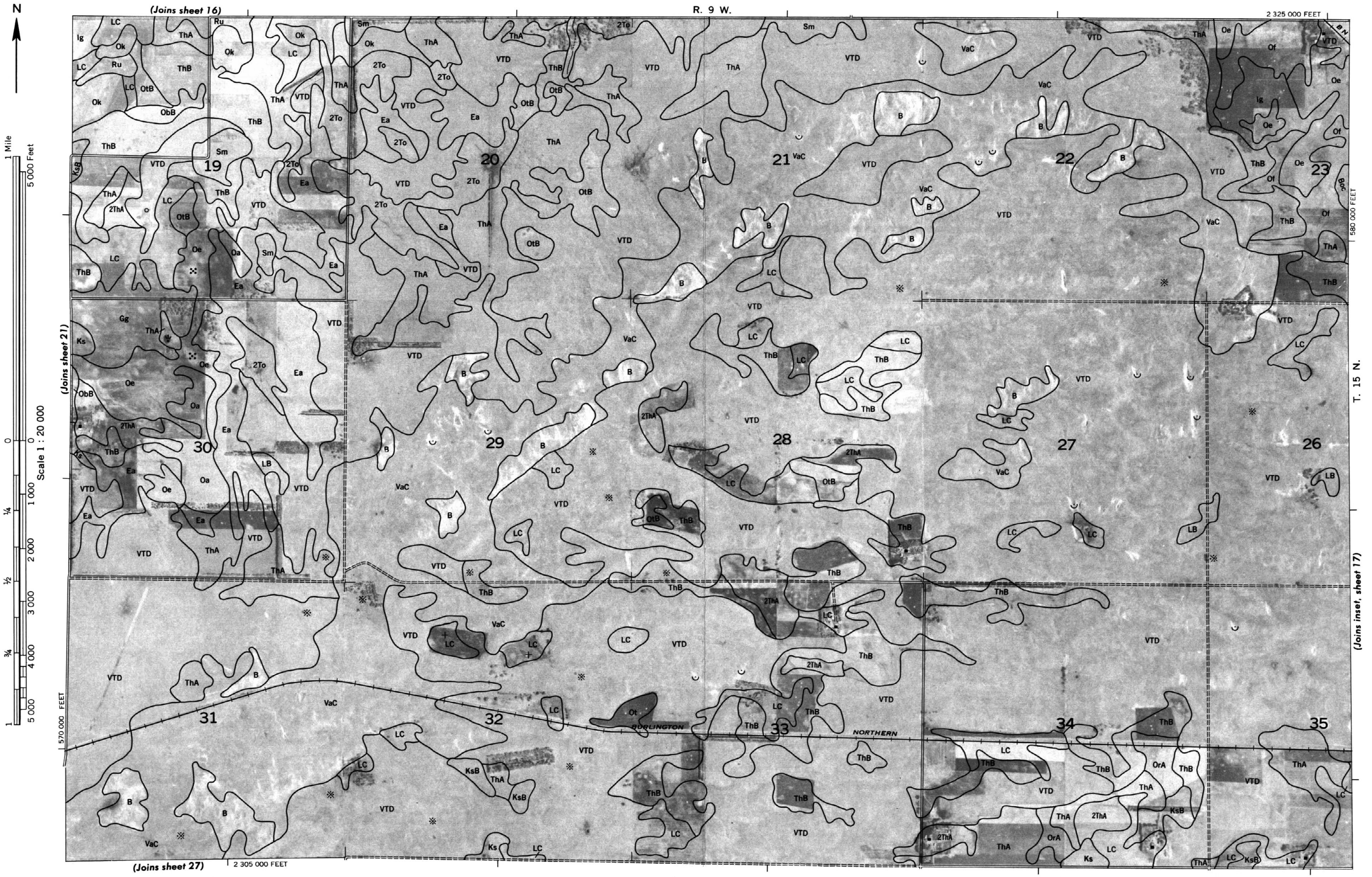
(21)



HOWARD COUNTY, NEBRASKA NO. 21

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.
Land division corners are approximately positioned on this map.

HOWARD COUNTY, NEBRASKA — SHEET NUMBER 22



Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.

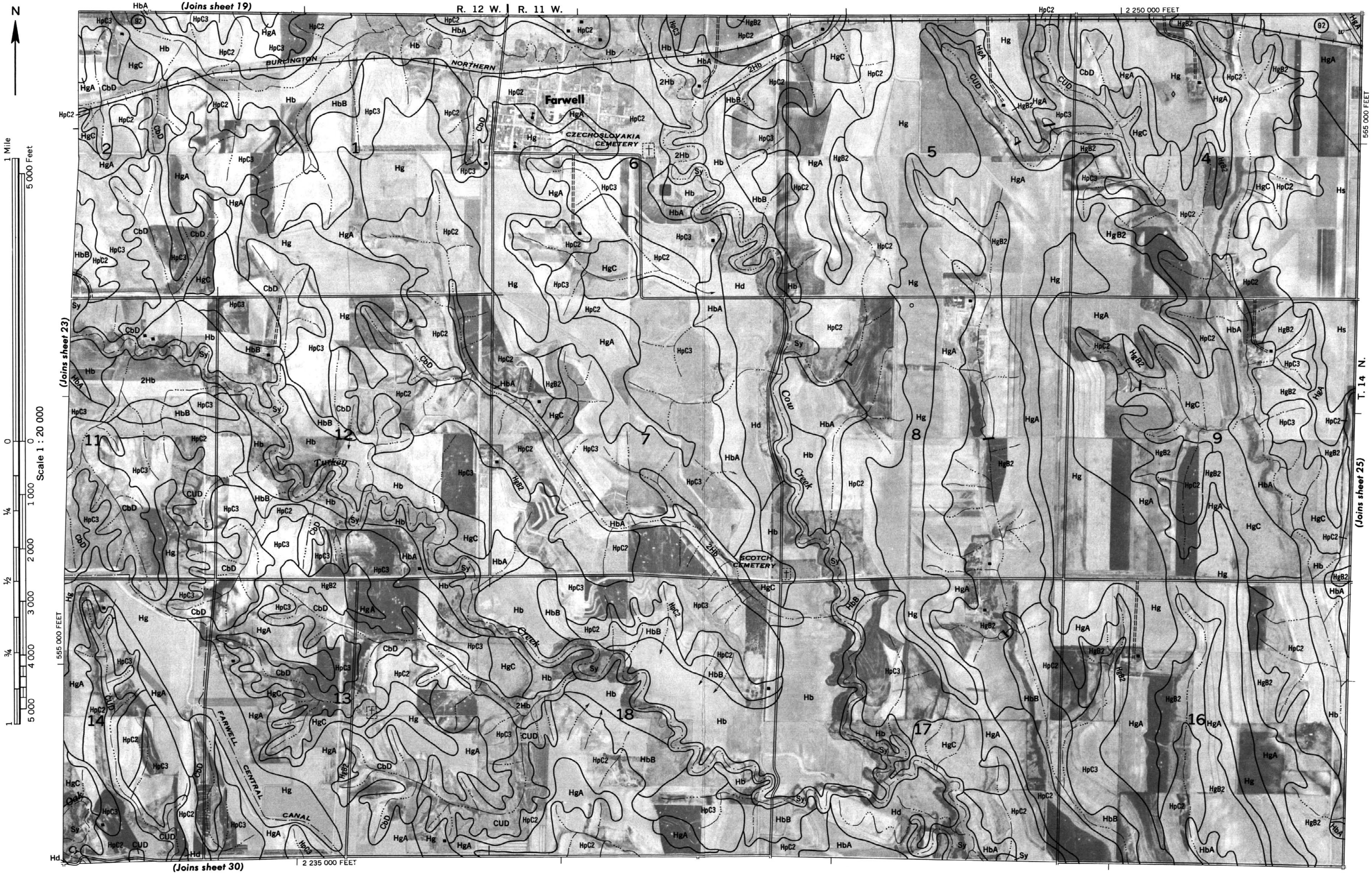
This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.

HOWARD COUNTY, NEBRASKA NO. 22

HOWARD COUNTY, NEBRASKA NO. 23

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.
Land division corners are approximately positioned on this map.

HOWARD COUNTY, NEBRASKA — SHEET NUMBER 24



Land division corners are approximately positioned on this map.

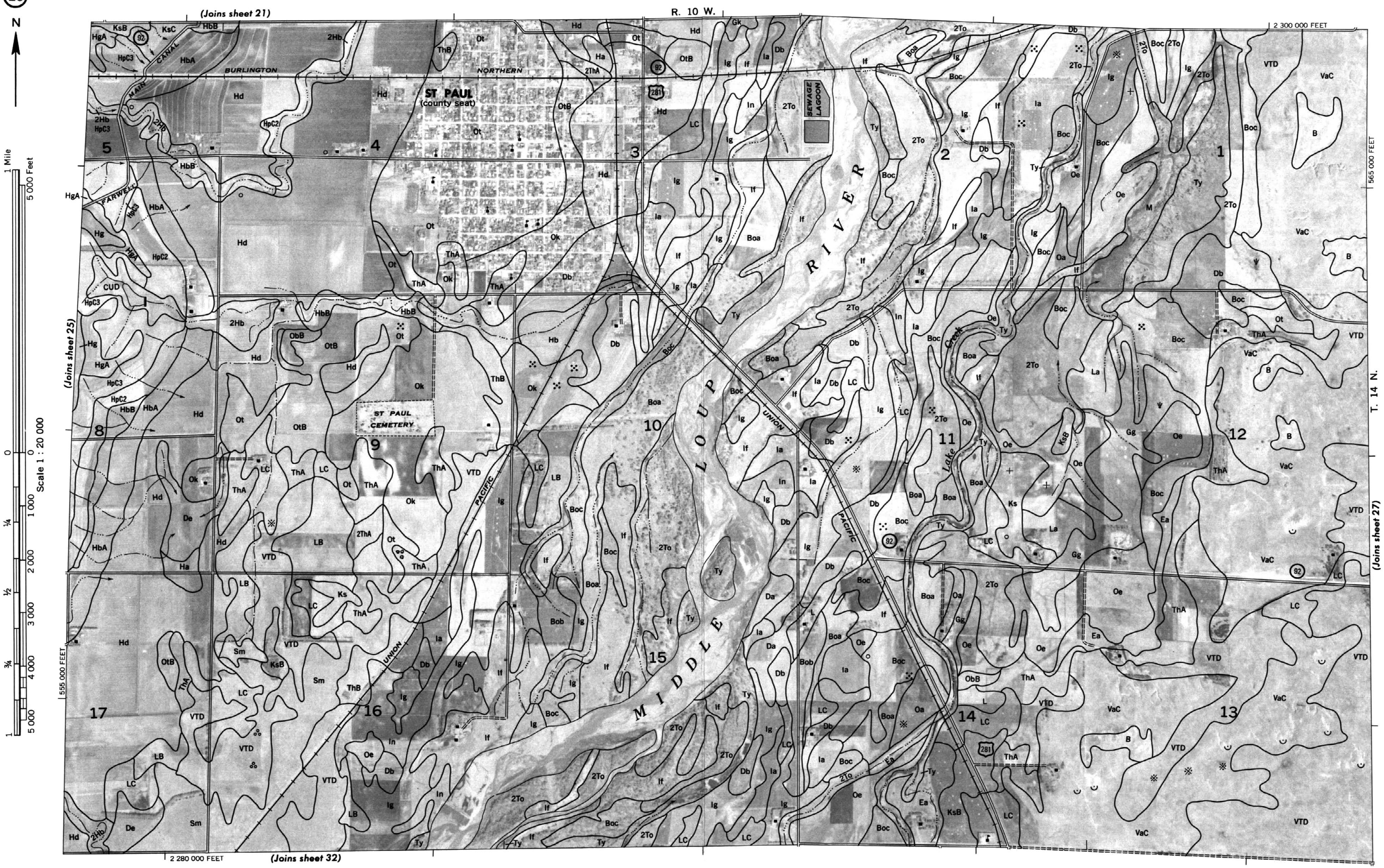
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.

HOWARD COUNTY, NEBRASKA NO. 24

HOWARD COUNTY, NEBRASKA NO. 25

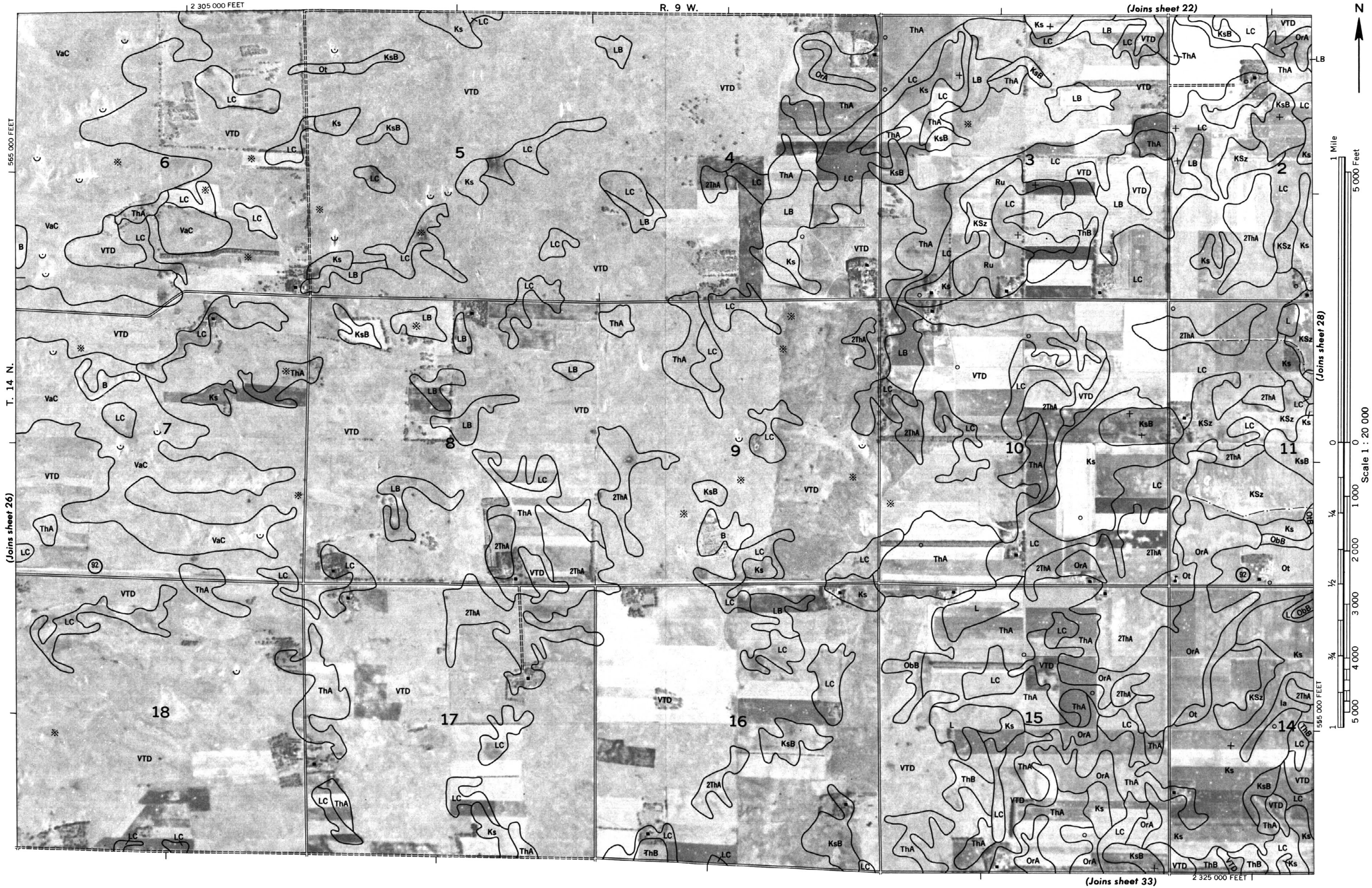
This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division. Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone. Land division corners are approximately positioned on this map.



Land division corners are approximately positioned on this map.

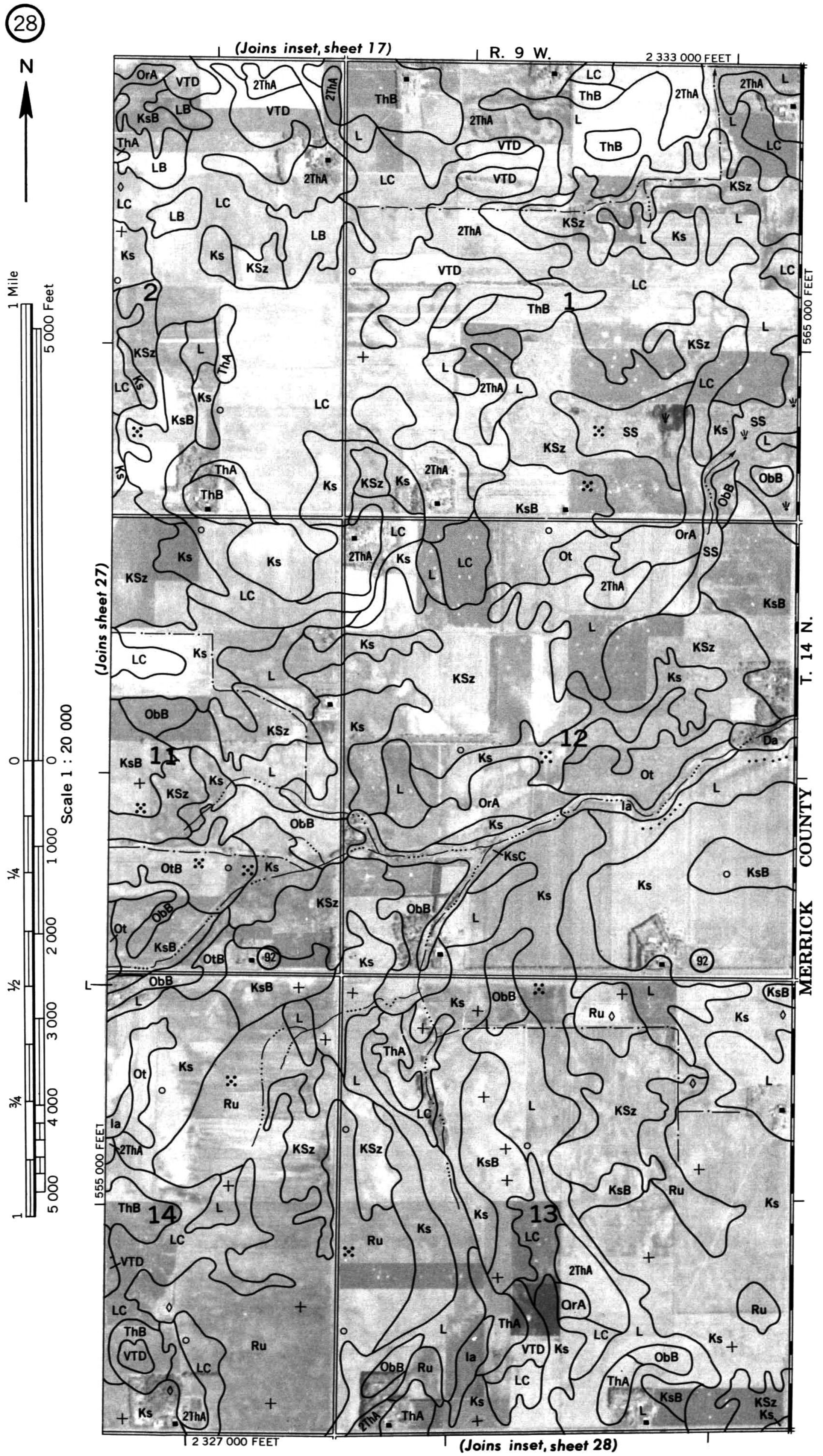
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.

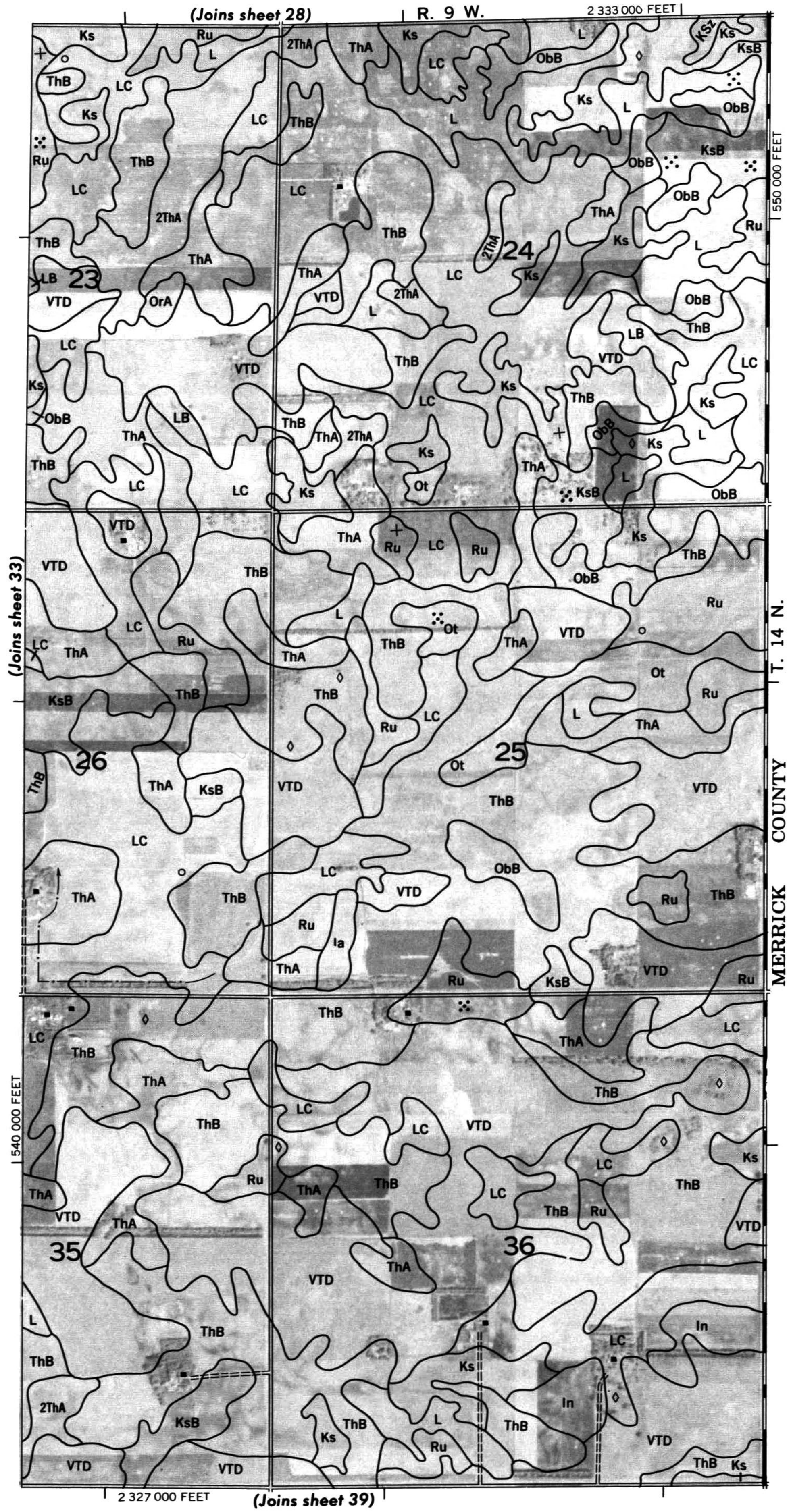


HOWARD COUNTY, NEBRASKA NO. 27

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.
Land division corners are approximately positioned on this map.



3 000 AND 5 000-FOOT GRID TICKS

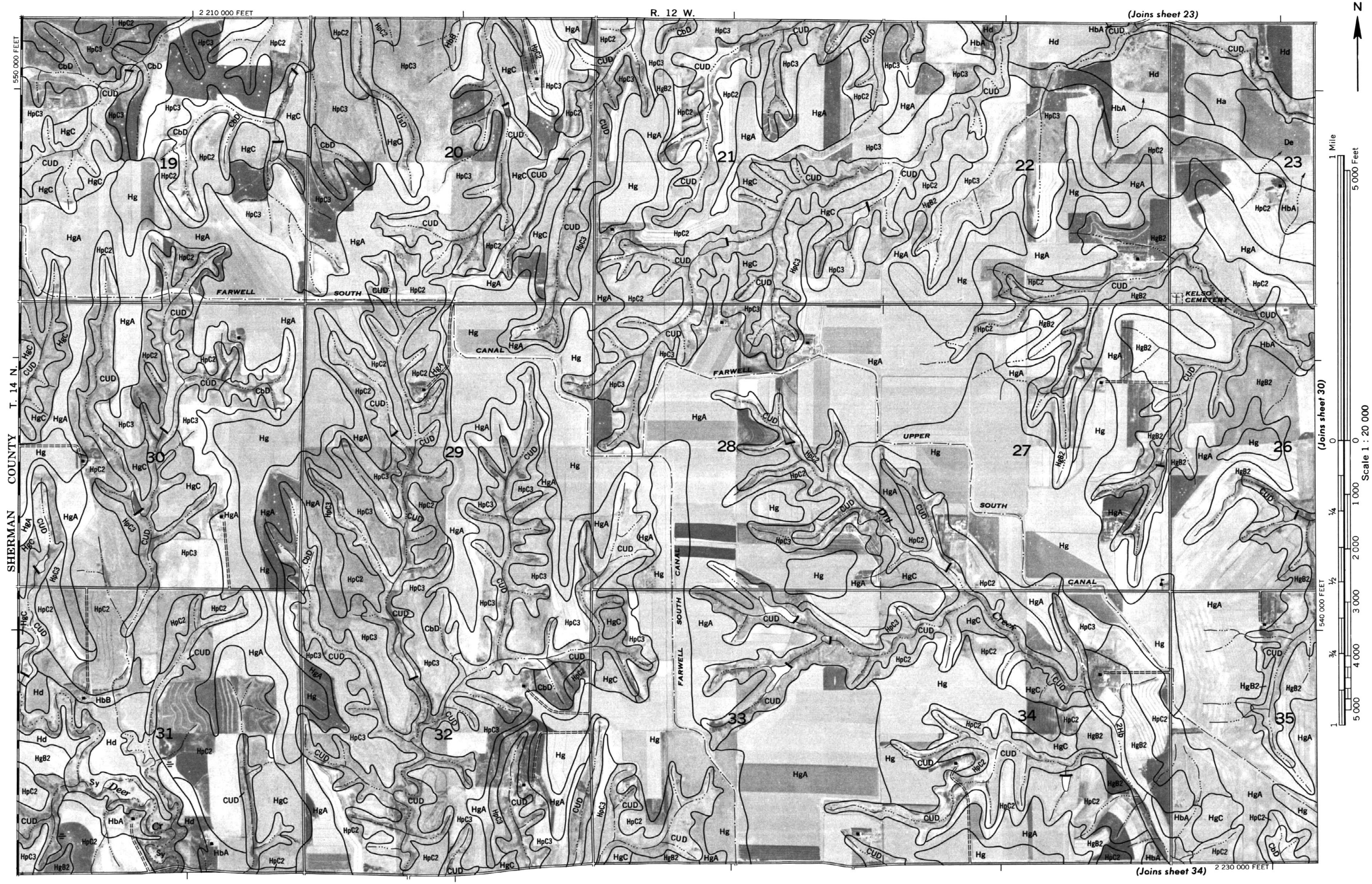


3 000 AND 5 000-FOOT GRID TICKS

Land division corners are approximately positioned on this map.

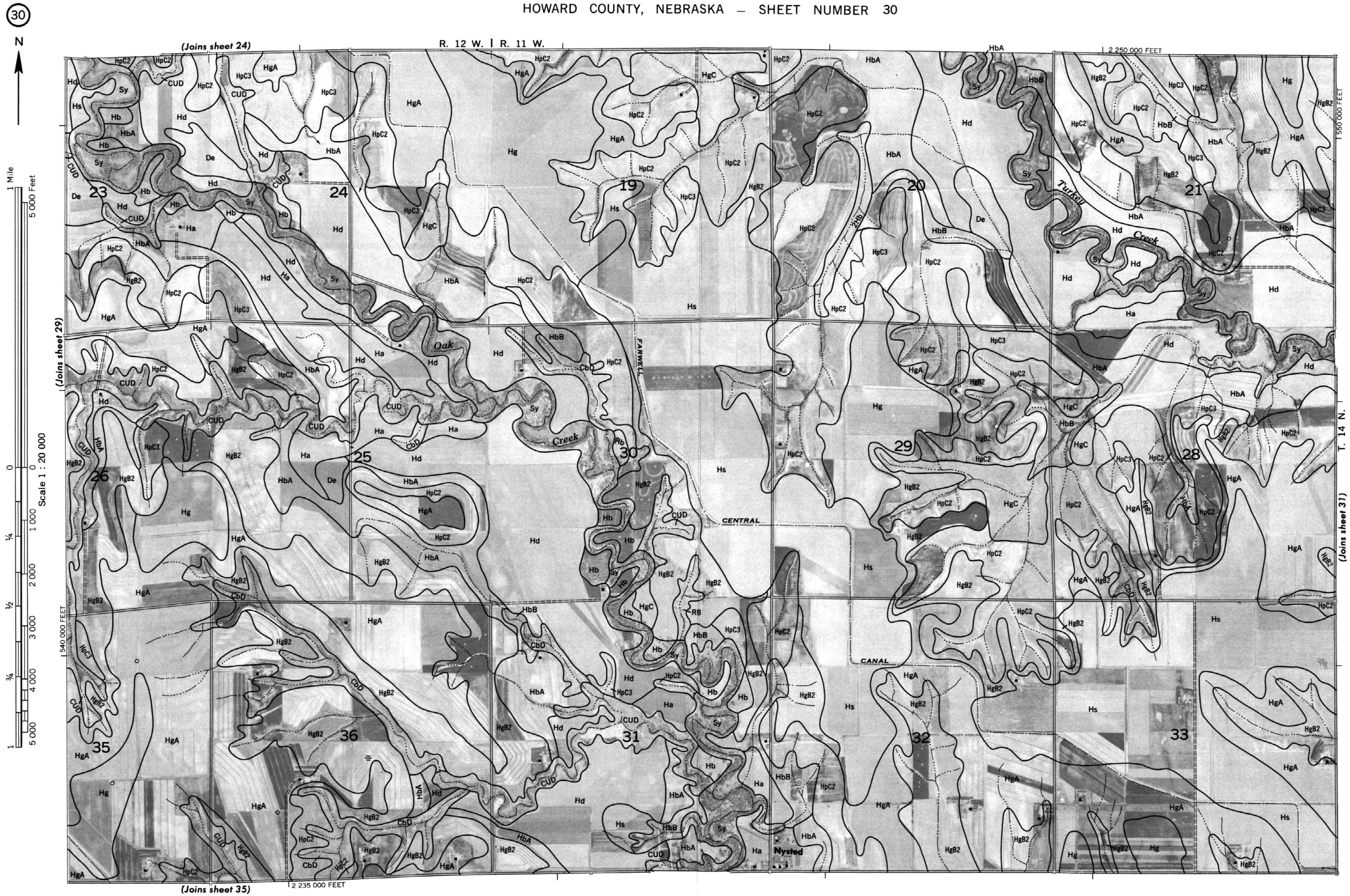
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.



HOWARD COUNTY, NEBRASKA NO. 29

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.
Land division corners are approximately positioned on this map.



Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.

HOWARD COUNTY, NEBRASKA NO. 31

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.
Land division corners are approximately positioned on this map.

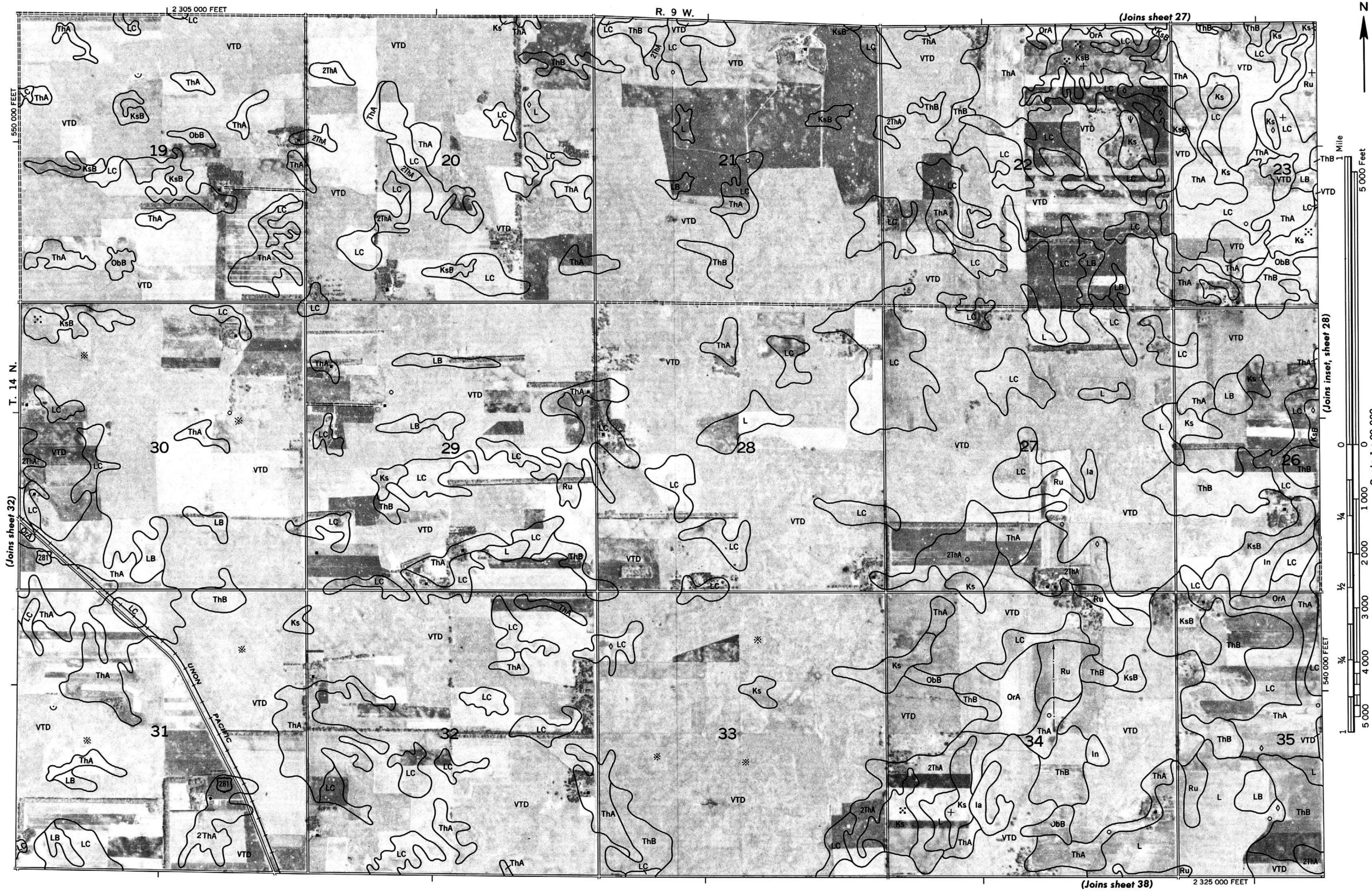
HOWARD COUNTY, NEBRASKA — SHEET NUMBER 32

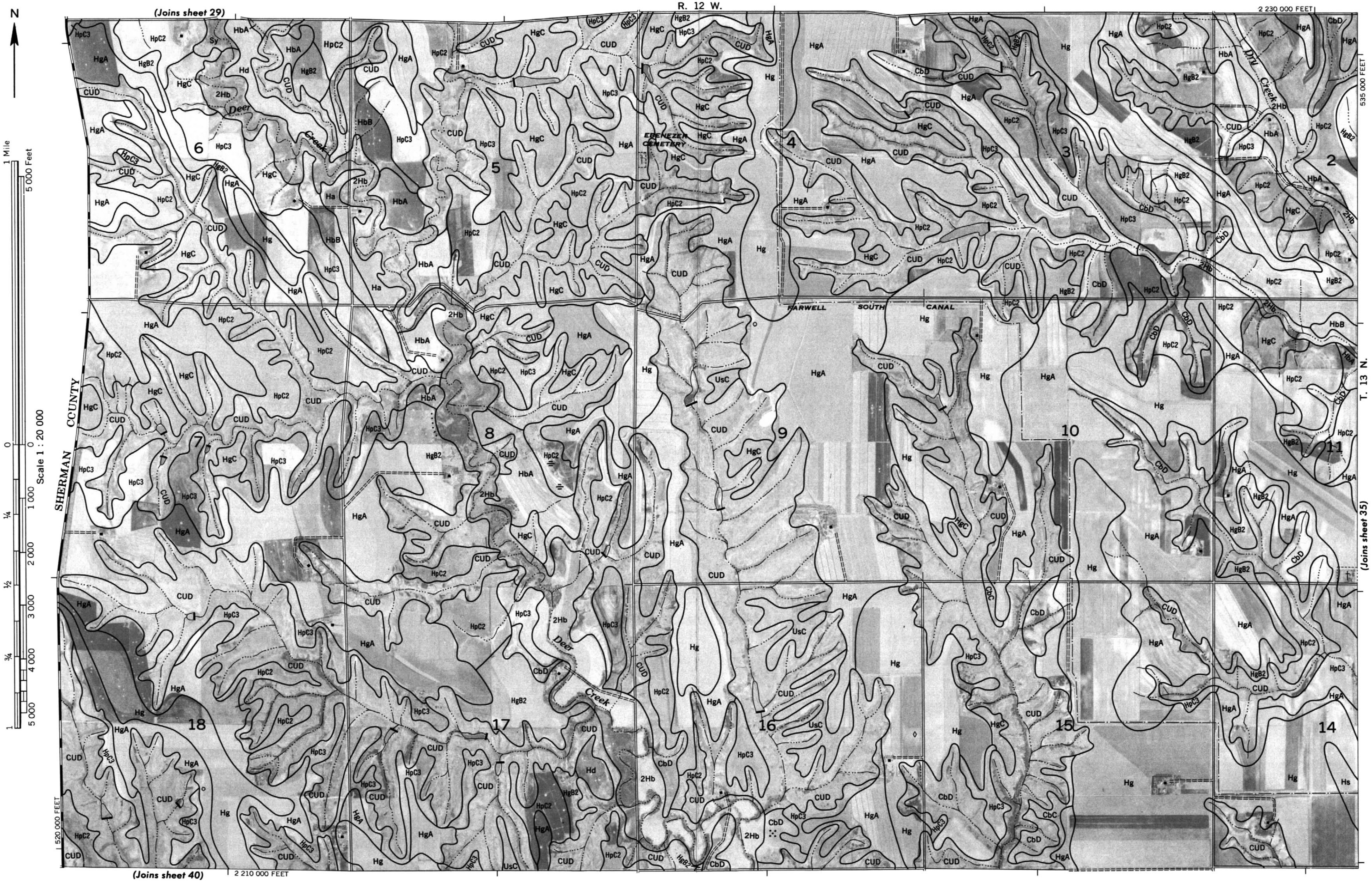
Land division corners are approximately positioned on this map.
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.
This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.

33

HOWARD COUNTY, NEBRASKA NO. 33

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.
Land division corners are approximately positioned on this map.

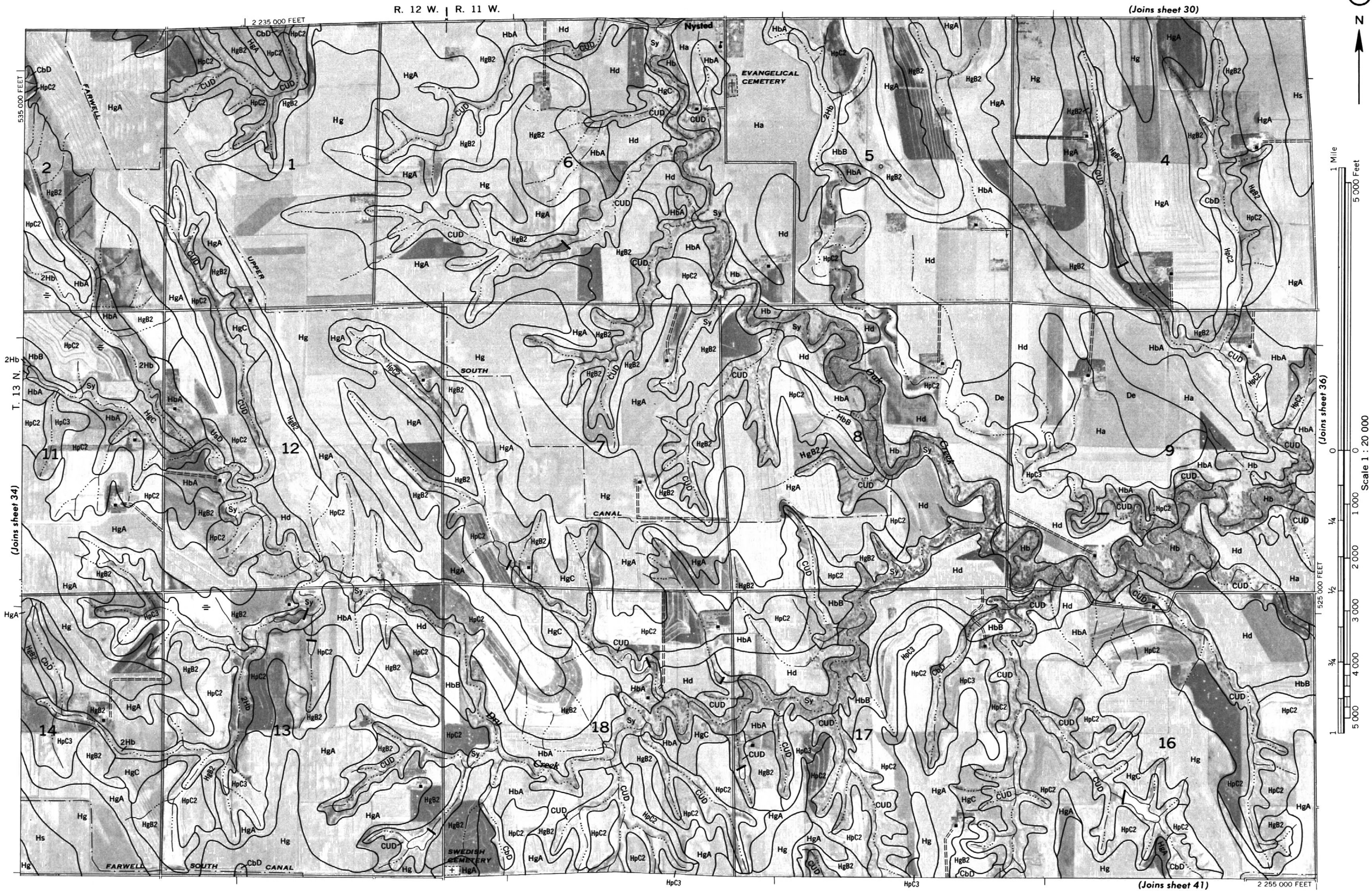




Land division corners are approximately positioned on this map.

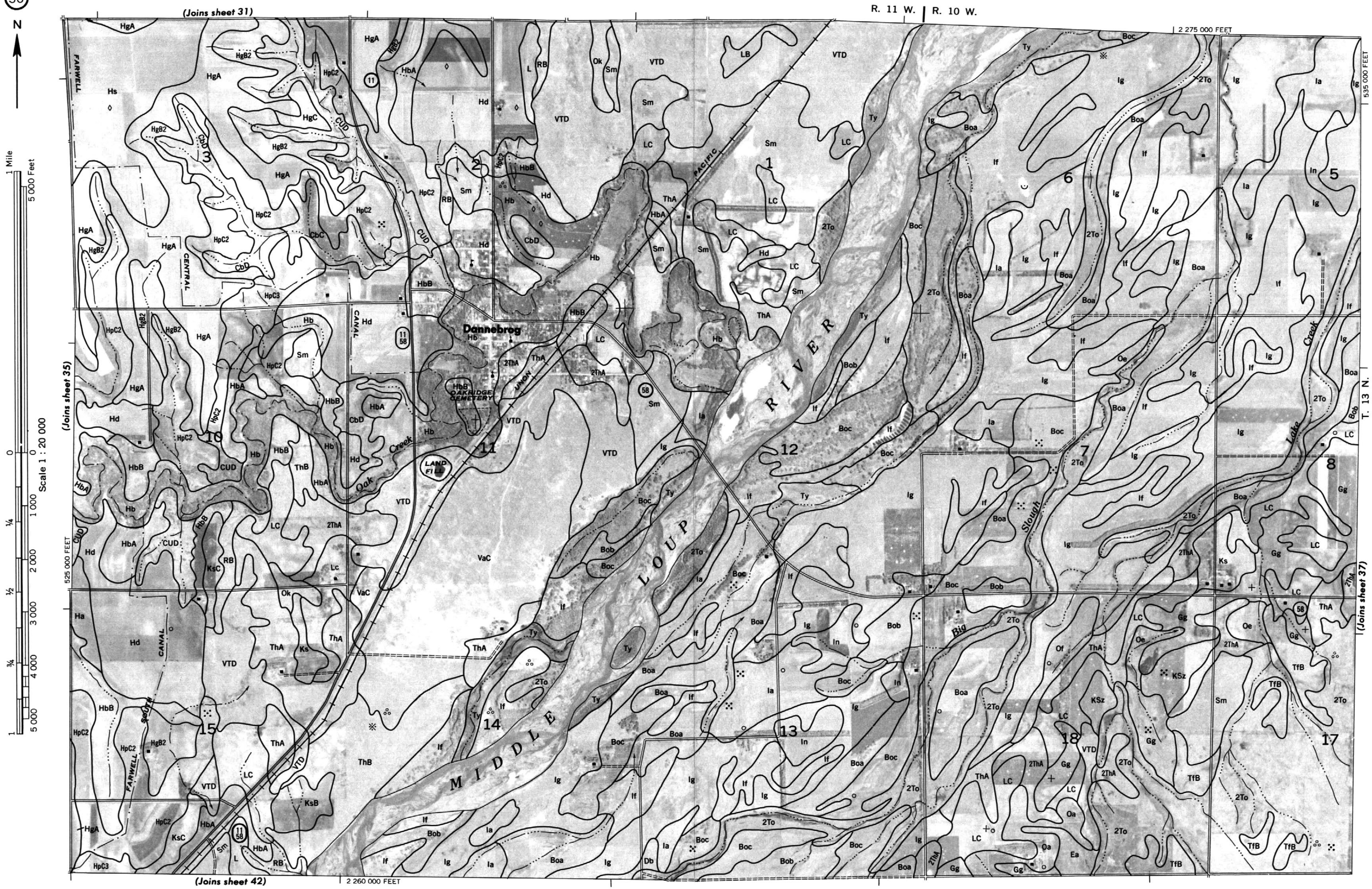
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.



HOWARD COUNTY, NEBRASKA NO. 35

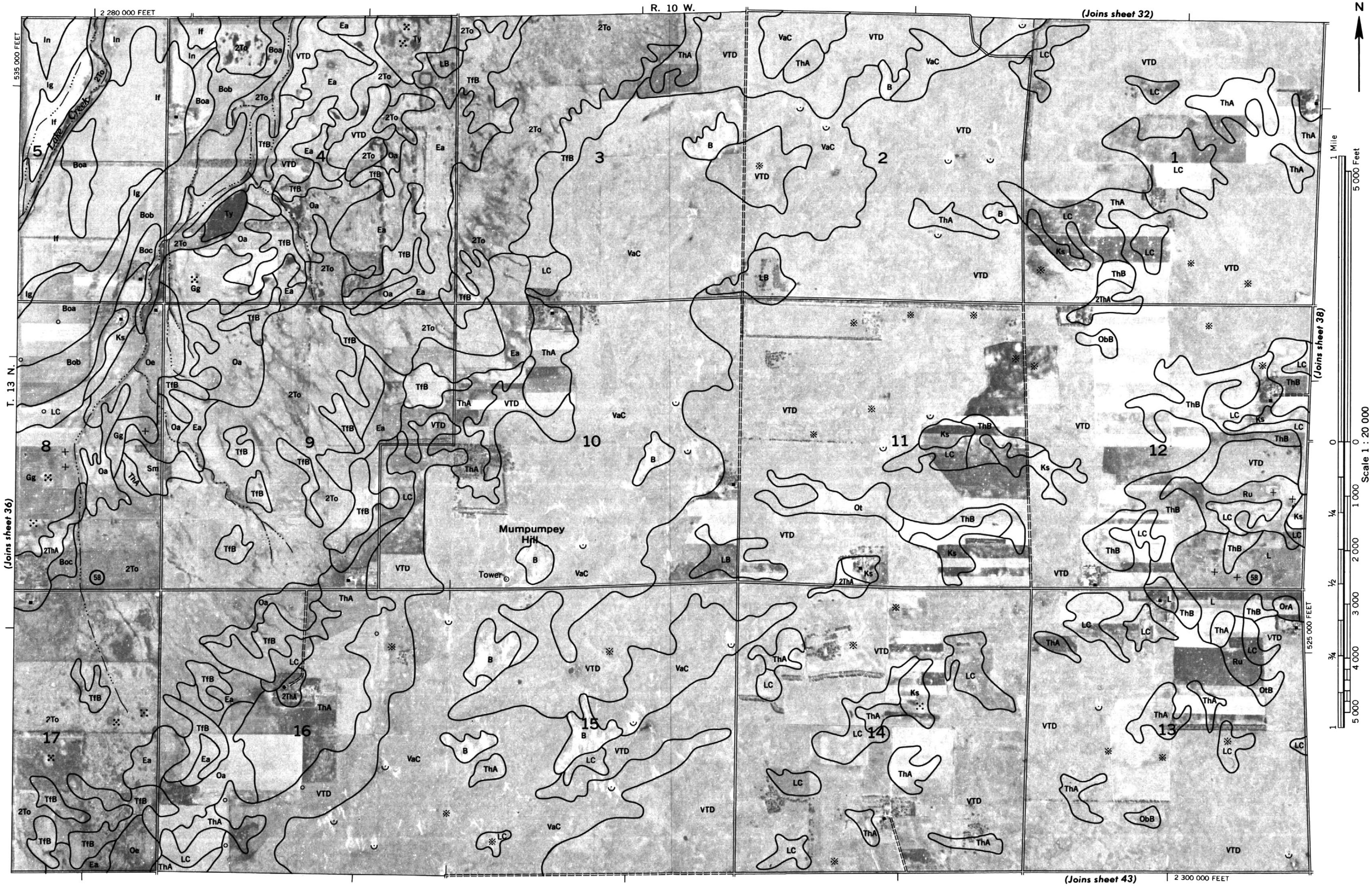
This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.
Land division corners are approximately positioned on this map.



Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.



HOWARD COUNTY, NEBRASKA NO. 37

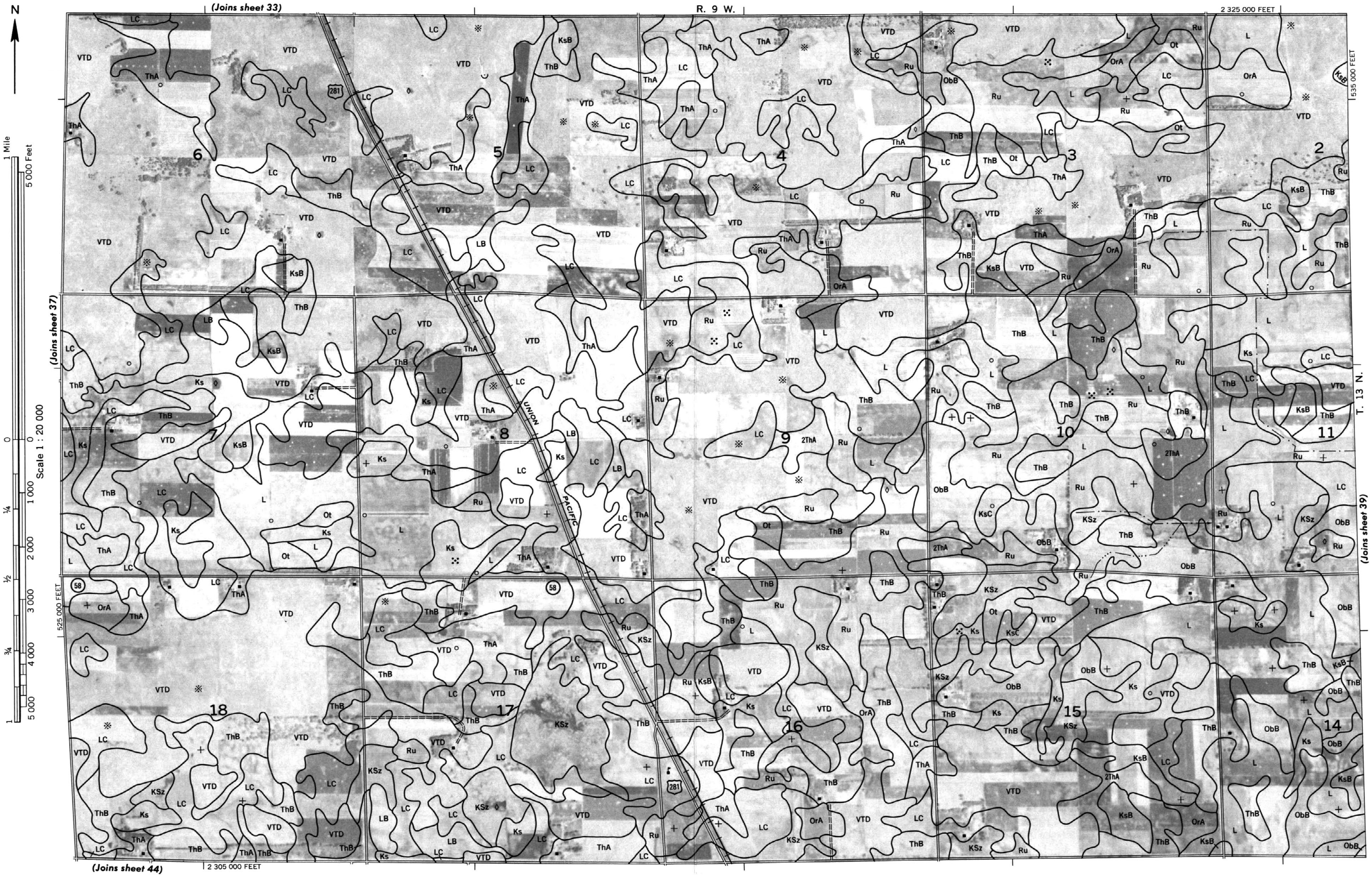
This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.

Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.

Land division corners are approximately positioned on this map.

38

HOWARD COUNTY, NEBRASKA — SHEET NUMBER 38



Land division corners are approximately positioned on this map.

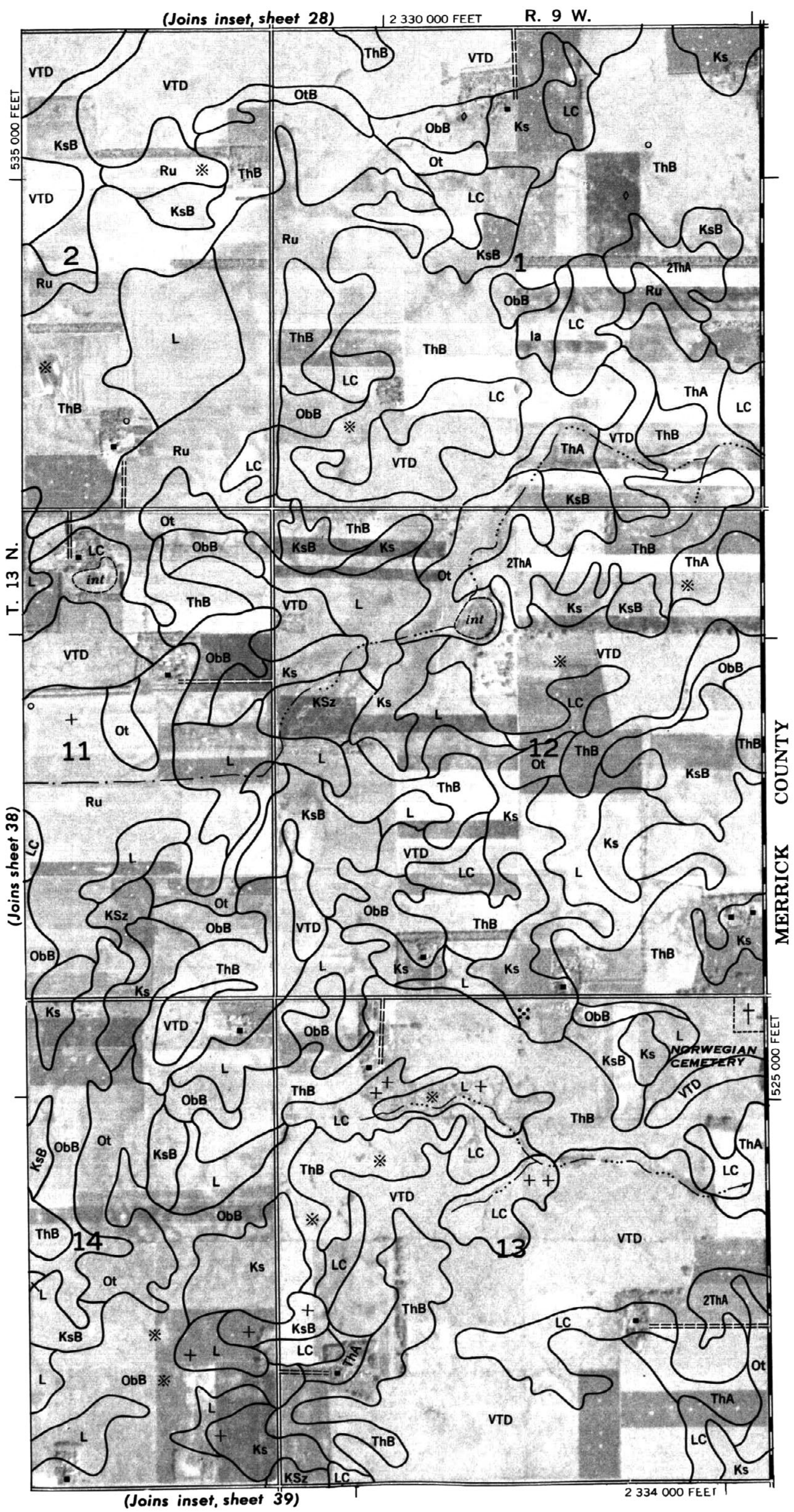
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.

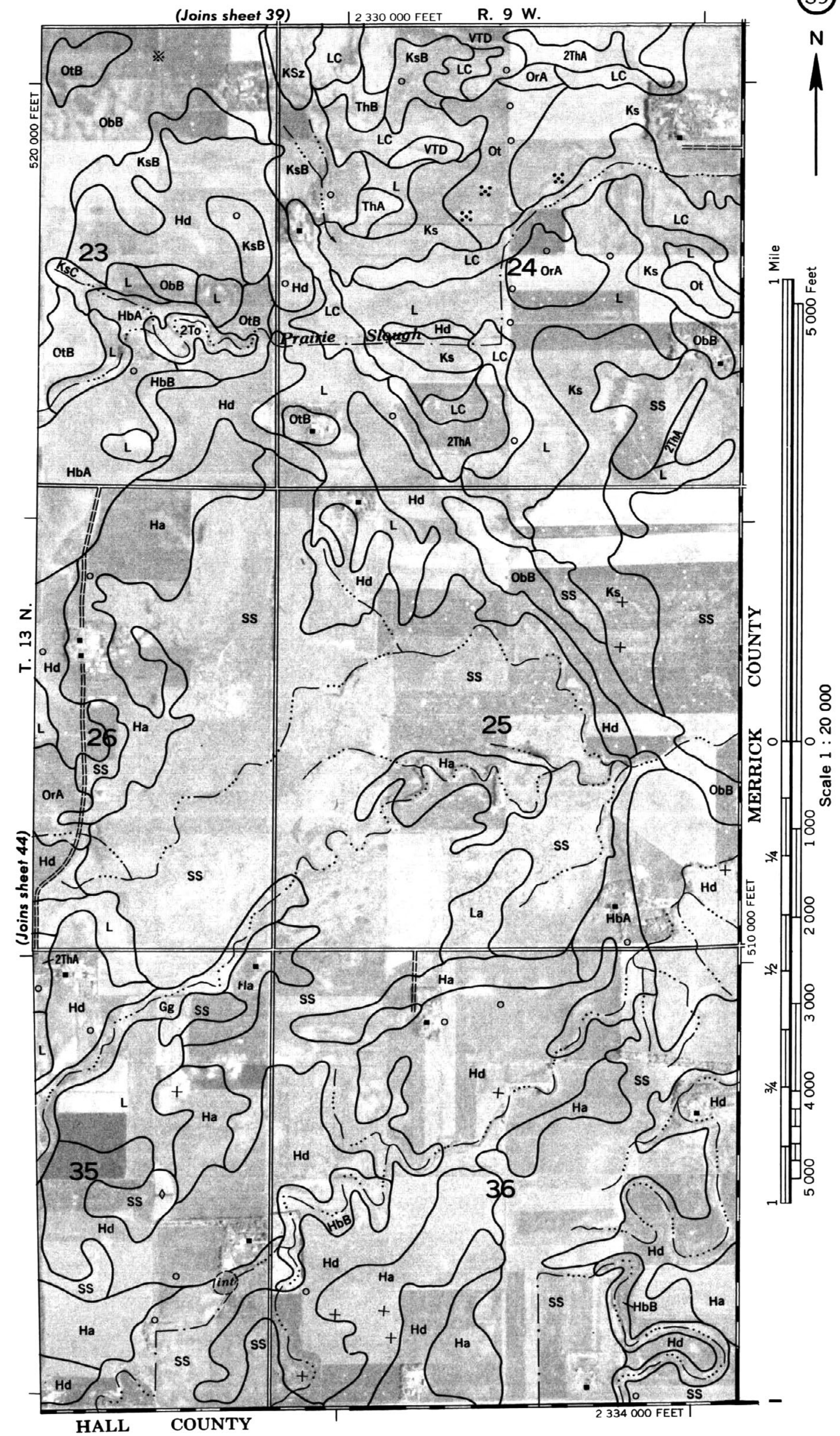
HOWARD COUNTY, NEBRASKA NO. 38

HOWARD COUNTY, NEBRASKA NO. 39

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.
Land division corners are approximately positioned on this map.

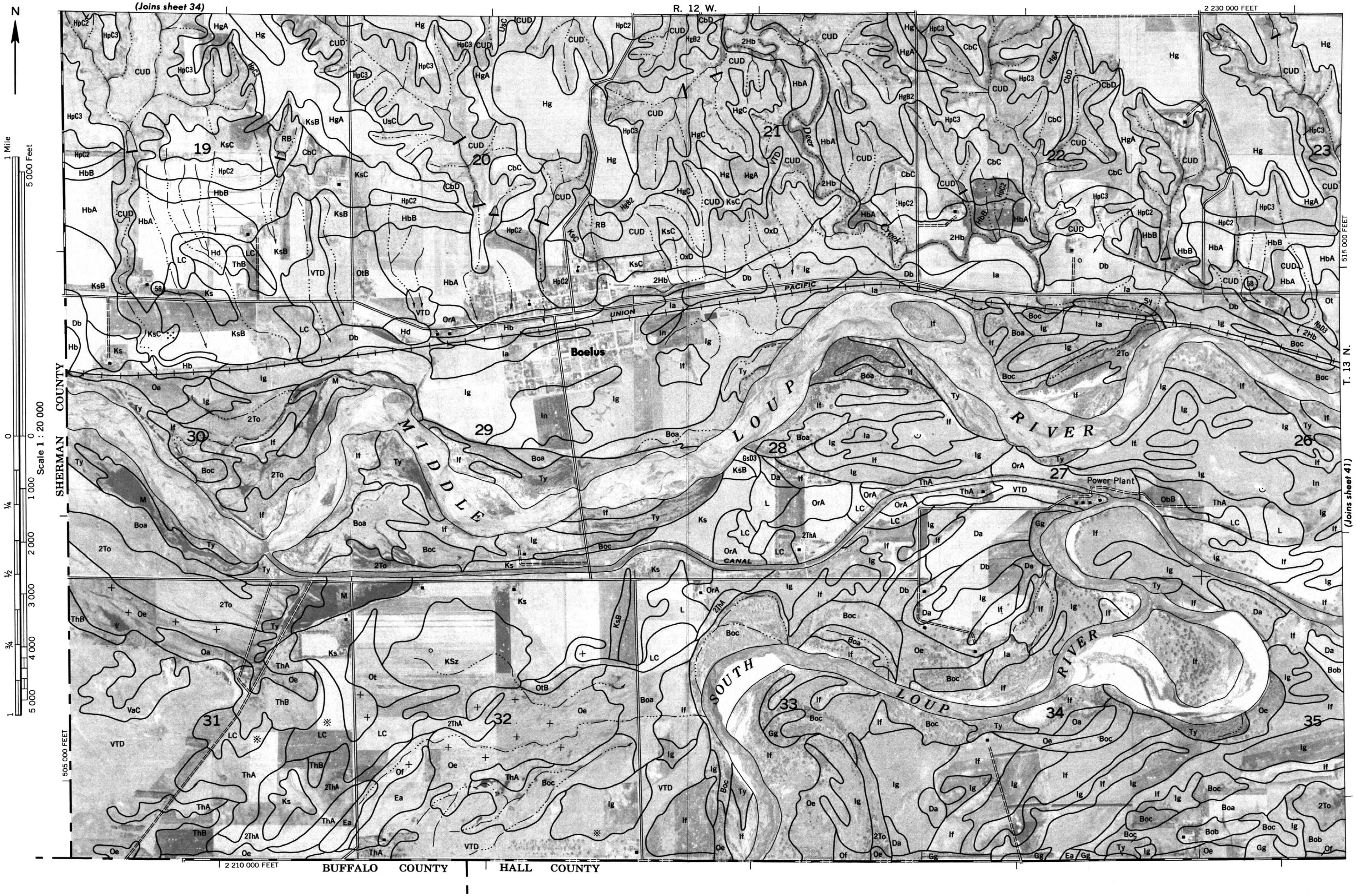


4 000 AND 5 000-FOOT GRID TICKS



4 000 AND 5 000-FOOT GRID TICKS

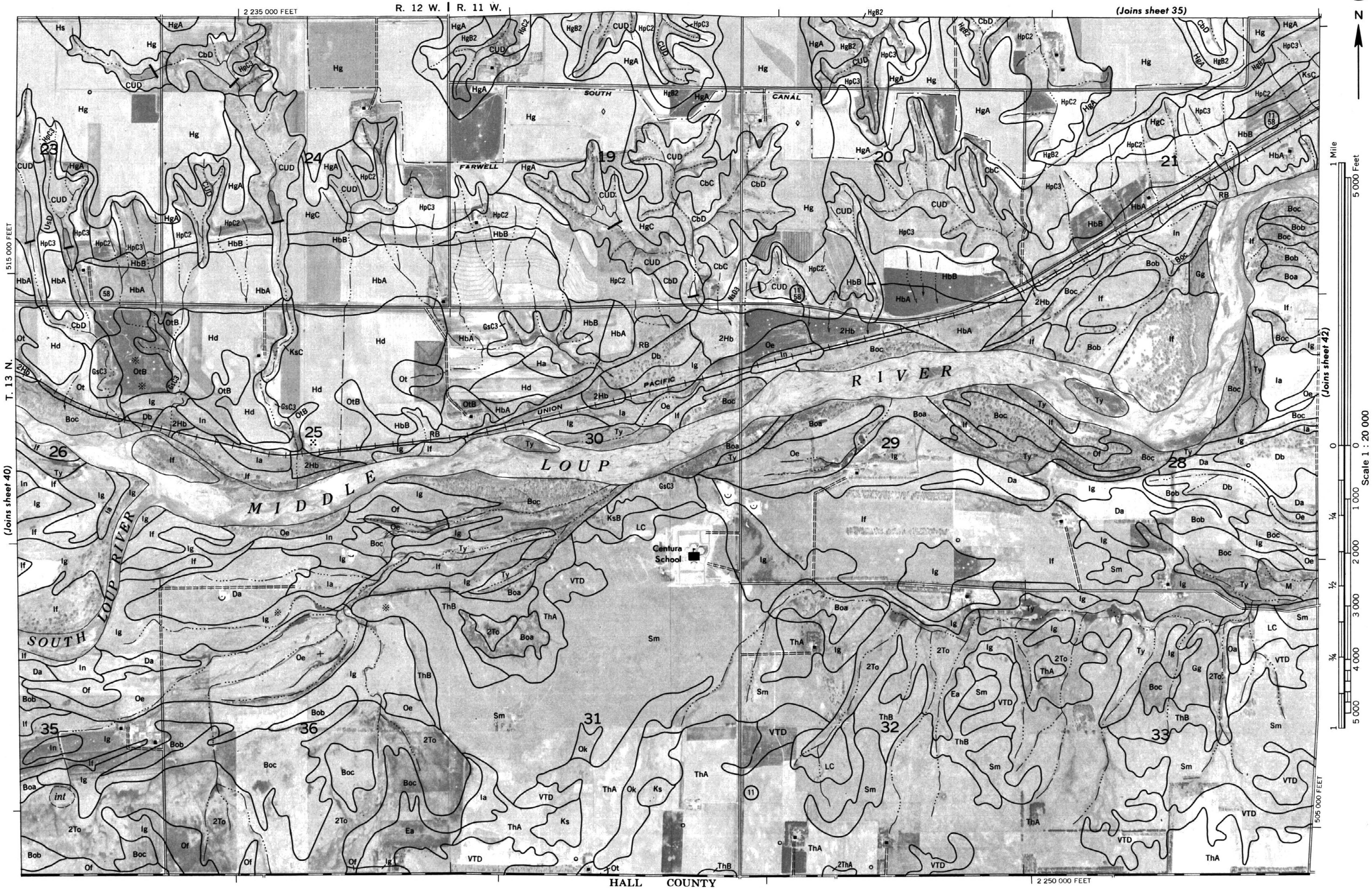
HOWARD COUNTY, NEBRASKA — SHEET NUMBER 40



Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.



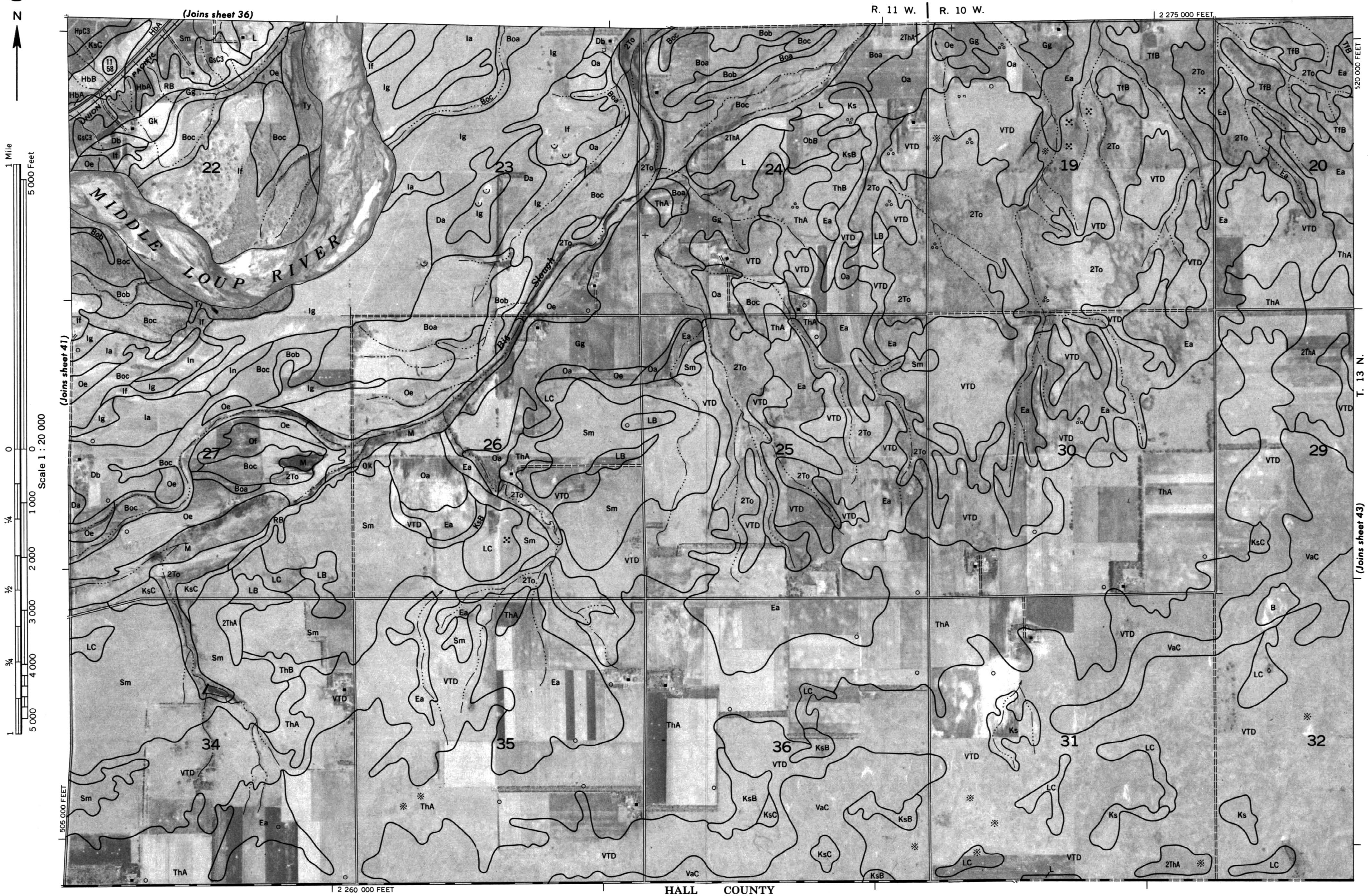
HOWARD COUNTY, NEBRASKA NO. 41

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.

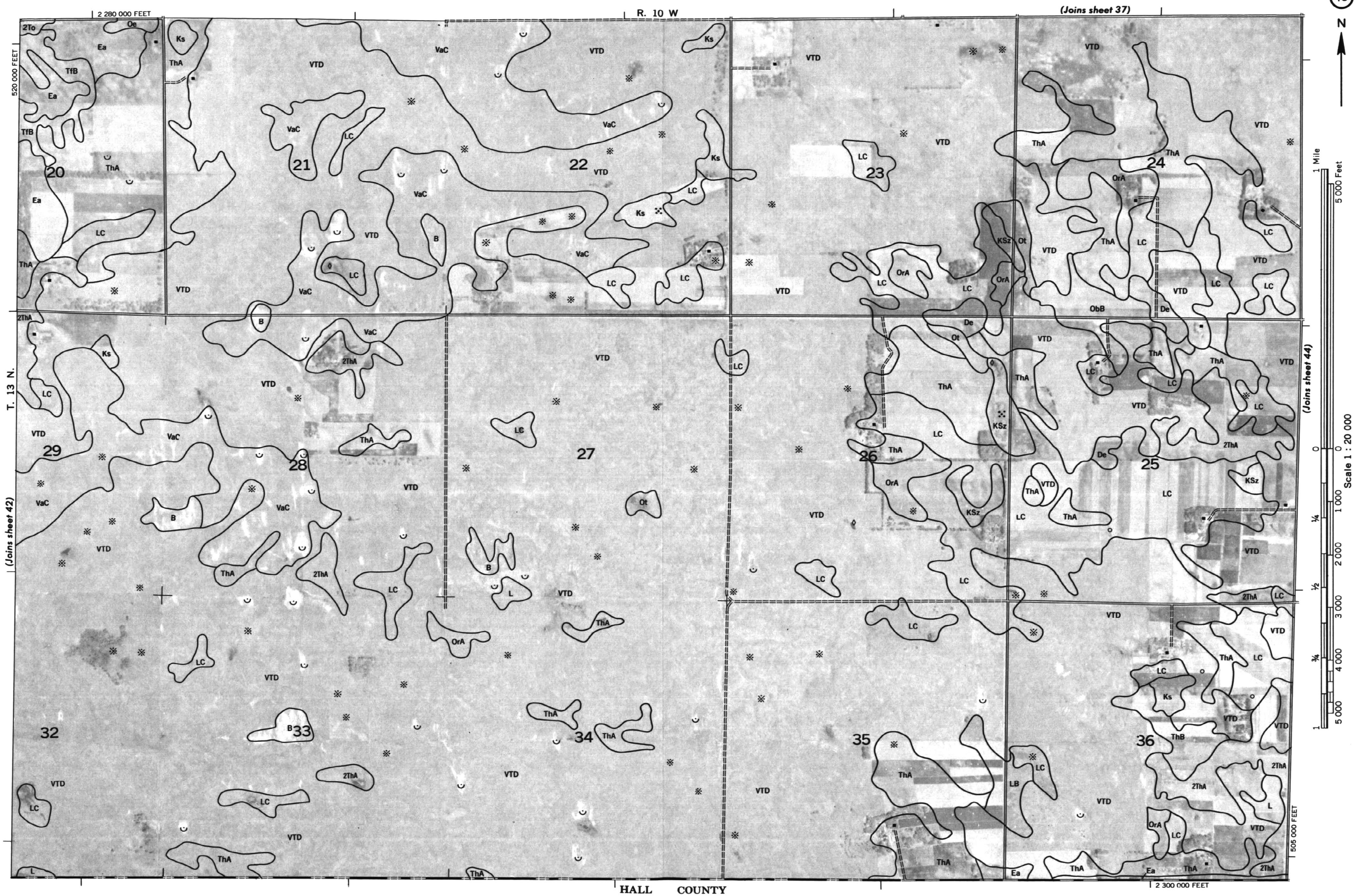
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.

Land division corners are approximately positioned on this map.

HOWARD COUNTY, NEBRASKA — SHEET NUMBER 42



Land division corners are approximately positioned on this map.
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.
This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.



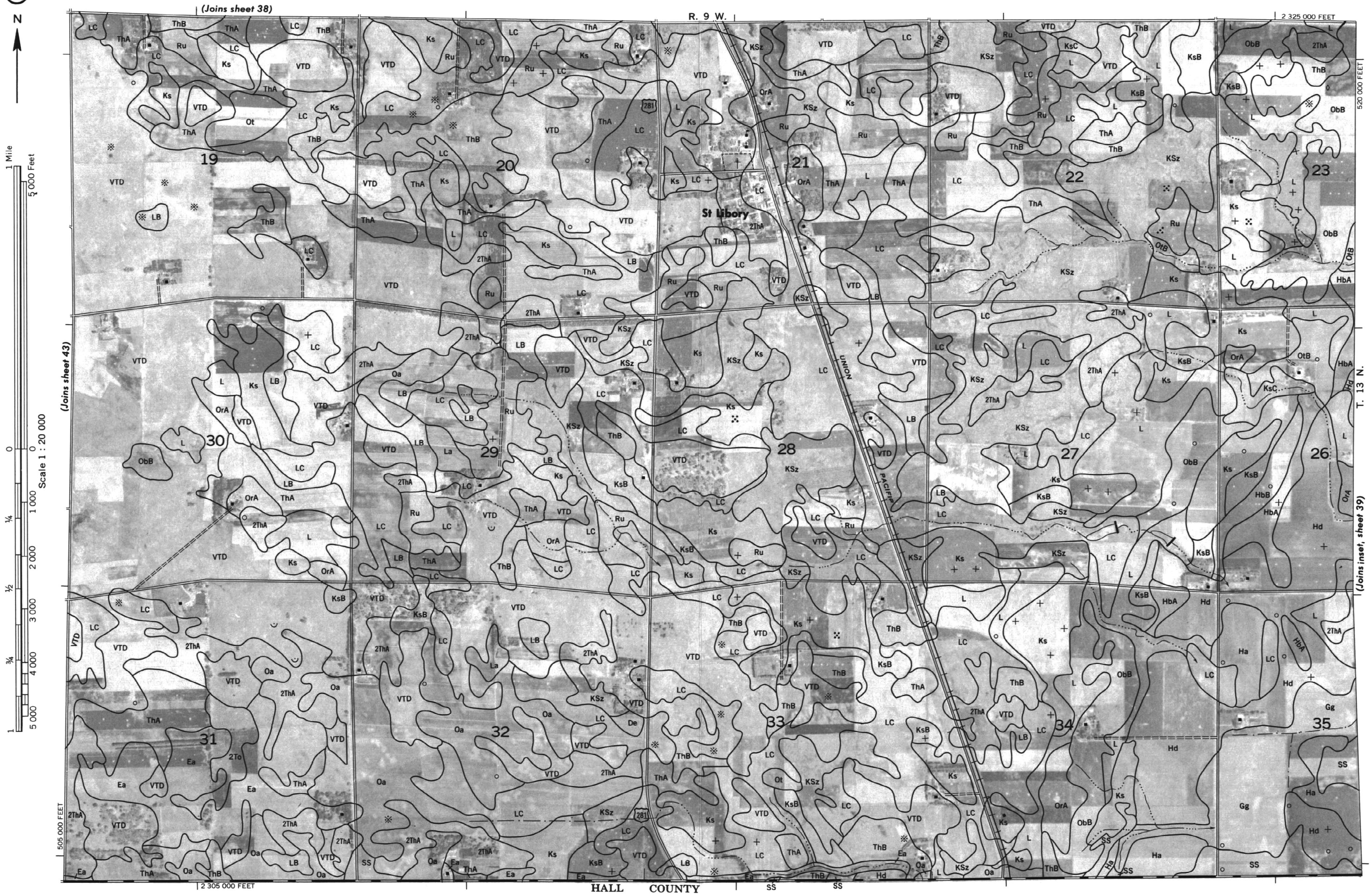
HOWARD COUNTY, NEBRASKA NO. 43

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.

Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.

Land division corners are approximately positioned on this map.

HOWARD COUNTY, NEBRASKA — SHEET NUMBER 44



Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.

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